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COMMONWEALTH MYCOLOGICAL INSTITUTE
31 JAN 1955

MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

THE QUARTERLY BULLETIN

The Quarterly Bulletin of the Michigan Agricultural Experiment Station is issued in February, May, August and November. It presents progress reports on long-term major research projects and final reports on short-term projects.

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THE QUARTERLY BULLETIN

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MICHIGAN STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
EAST LANSING

L. M. TURK, DIRECTOR
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IMPACT OF HORTICULTURAL INFORMATION ON TELEVIEWERS[1]

By LOUIS M. BERNINGER and DONALD P. WATSON

DEPARTMENT OF HORTICULTURE

RESEARCH in consumer education, an area of increasing interest and importance, has received only minor attention in the field of Horticulture. This research project was based on the idea that the buyer could not make an appropriate choice of a horticultural product without some basic information and without some way to link its use with his real or imagined needs.

[1]This paper is part of a research program in Horticultural television and is drawn from a thesis for the M. S. degree in Horticulture by the senior author.

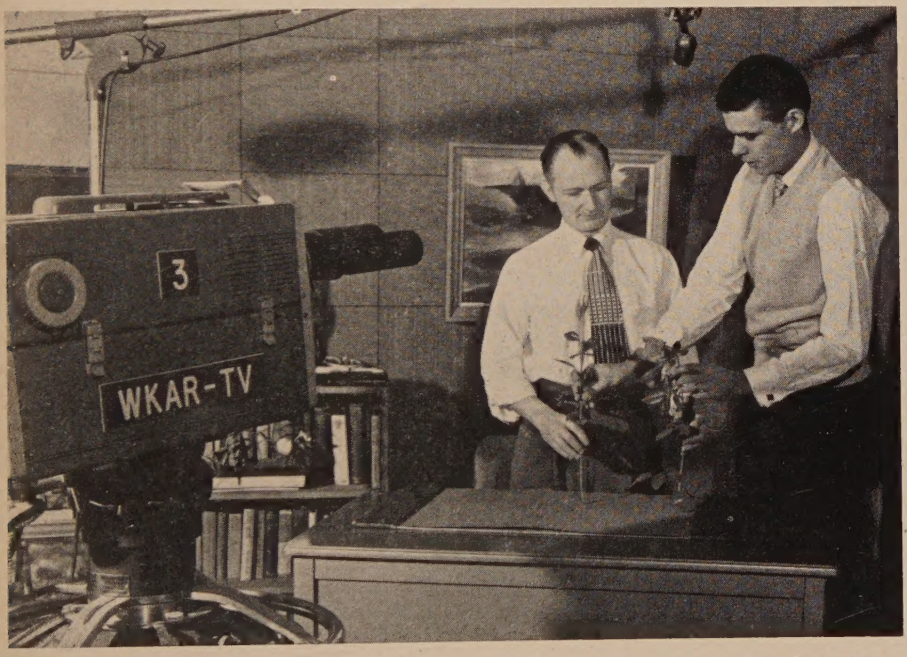

Fig. 1. Rehearsal of Program "Rose as a Cut Flower" showing Robert Wurdock (left) as professional cast and Louis M. Berninger as producer.

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The mass media of communication have assumed a primary role in delivering information concerning available products and their uses to the people. With the advent of television, this type of communication activity has been increased many fold. (3), (5), (6).

Sponsors and potential sponsors of television advertising have had many unanswered questions regarding the effectiveness of this new medium. The relationship of two minute programs in aiding learning and influencing attitudes has not been reported.

Consequently, the present study was designed to measure the impact of two minute horticultural programs on existing knowledge and attitude levels, on recall value, and on viewers preference.

PROCEDURE

To represent a program in consumer education, three areas of horticulture were chosen for their adaptability to television. Two minute television productions were prepared using the rose as a cut flower (Fig. 1), peas as a frozen vegetable and Japanese yew as a nursery crop.

To broaden the scope and intensity of this study, three productions were devoted to roses and one program to each of the other two commodities.

All kinescopes were designed to correspond with television commercial announcements. Only the fundamental values and benefits of the products were demonstrated by the use of one person in a lecture-demonstration presentation. The type and length of material governed both the selection of this format and the selection of the performer (2).

Eight classes of university students enrolled in a course of Basic English at Michigan State were exposed to the following:

Pre-test: The pre-test presented on April 9, 1954 was designed to obtain existing knowledge and attitude levels in relation to the horticultural products discussed in each production.

Post-test: The post-test, administered five days following the pre-test and immediately following exposure, measured the effectiveness of the recordings on the basis of attitude, knowledge and preference.

Recall-test: A recall-test administered three weeks later to measure the learning-recall value.

Open-end questions were employed to measure the results of information over a period of three weeks. A series of scales developed

TABLE 1—Mean value of pre, post, and recall tests from televiewers

Groups	Pre-test percent	Post-test percent	Recall-test percent
"Quality of Roses" Control	21.7	17.0	....
I	24.7	87.0	71.3§
IV	17.7	80.3*	66.6§
V	17.7	86.0	59.3§
"Care of Roses" Control	19.3	17.0	....
II	18.7	77.7	63.0§
IV	13.7	74.7	52.0§
V	11.3	74.7	42.3§
"Use of Roses" Control	41.6	33.0	....
III	50.4	78.4	67.6§
V	42.0	79.2	72.0§
"Frozen Peas" Control	30.5	41.2	....
VI	44.5	65.0	....
"Japanese Yews" Control	18.0	19.8	....
VII	21.5	50.3	....

*Beyond 5% level of significance
†Beyond 1% level of significance
‡Beyond 5 and 10% level of significance
§Not significant

by Osgood (4), were used for the measurement of attitude changes as a result of exposure to information (7). The Wilcoxin non-parametric paired replicate test (8), and the Analysis of Variance (1), were used to determine the significance of the results.

DISCUSSION OF RESULTS

The present study demonstrated that a random selection of university students had very little horticultural information. This indicated that horticultural industries should be aware of the lack of horticultural knowledge on the part of consumers.

Television Recordings Effective in Aiding Learning

From the results for five programs presented in Table 1, it may be seen that recordings ("Quality of Roses" and "Care of Roses") produced a positive change in learning and one ("Use of Roses") was very close to the arbitrarily accepted 5 percent level of significance. Although increases in learning were reported by the other two productions, "Frozen Peas" and "Japanese Yews", the actual changes were not significant. As exposure to information was increased from two to four and six minutes, proportionate increases in learning occurred. In light of these results, there was an indication that

exposure to several short commercials over a period of a few hours might produce further and continuing increases in learning.

It must be realized that consumers have had the privilege of accepting or disregarding information designed to increase their knowledge. Therefore, knowledge of the consumers' reaction to the presentation of information through short television announcements was very essential. The results of this study have indicated the potential effectiveness of horticultural education to a purchaser of television advertising time.

A Change in Attitude Was Obtained

After being exposed to six minutes of horticultural information, the original favorable attitude of a captive audience was improved. The results of this test indicated that two significant changes in attitude occurred. Group V, the same group that produced significant increases in learning, produced a significant positive change in attitude (5 percent Level).

A significant negative change in attitude was produced by Group IV, (1 percent Level). It was possible that complete cooperation was lacking on the part of the viewers which resulted in a negative change in attitude.

These results might imply that these horticultural products had aroused unfavorable attitudes on the part of the public, through traditions and misconceptions, and it might be advisable to alter present methods of advertising. An advertiser could have accomplished increases in both knowledge and favorable attitude levels by using informative "commercials".

Excellent Retention of Information

The three short programs on roses possessed sufficient impact to remain with the students for a period of three weeks. The results of the recall test as presented in Table 1, demonstrated that significant decreases in learning and changes in attitudes did not occur on any of the groups receiving exposure to two, four and six minutes of information.

The importance of reinforcing learning with a strong summary was vividly demonstrated. In the recording on "Care of Roses", the performer omitted the use of a sharp knife in summarizing the discussion. Forty-five percent of the students on the post-test, and 75

percent of the students on the recall test, omitted this answer when asked the open-end question concerning this fact.

To a sponsor, the retention of knowledge and attitude levels might have indicated that continual reinforcement of the information was not essential for at least a period of three weeks.

Students Indicated a Preference for Informative "Commercials"

The students indicated a definite preference for the television recordings used as "commercials" at this time (Table 2). This was strengthened when increasing the exposure to information did not result in a decrease in preference. This suggested that the public would accept information through this method of communication.

All phases of the two minute productions studied indicated that they had a high potential in obtaining and sustaining a more enlightened consumer.

TABLE 2—Measure of preference of groups of university students for informative "Commercials" (averaging 21 students per group)

Group	"No" answers	Unfavorable answers	Favorable answers	Enthusiastic answers
I.....	1	4	13	04
II.....	0	4	12	03
III.....	1	4	13	06
IV.....	0	2	14	01
V.....	1	4	06	10
VI.....	3	6	10	03
VII.....	0	8	13	00
Total.....	6	32	81	27
Percent.....	4.11	21.92	55.48	18.49
	26.03 Unfavorable		73.97 Favorable	

SUMMARY

The results of the tests showed that the beginning levels of knowledge on various horticultural topics were extremely low, while the beginning attitude levels were favorable.

Two-minute television programs were effective in aiding the learning process. A significantly high percentage of information was

immediately absorbed. Over a period of three weeks, the retention of this information was excellent, with no occurrences of significant decreases in knowledge.

An audience exposed to six minutes of information produced a significant positive increase in attitude. When retested three weeks following exposure, no significant changes in attitude were found.

The learning and retention of information as indicated in this study was heightened by the reinforcement of information through a brief but strong summary.

A high percentage of the students viewing the two minute productions endorsed the use of similar television commercials in spite of the fact that the recordings were not completely professional in character.

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INTERACTION OF SOME ENVIRONMENTAL FACTORS AND THE GROWTH OF SALVIA SPLENDENS

By CALVIN C. COOPER and DONALD P. WATSON

DEPARTMENT OF HORTICULTURE

Salvia splendens, with its outstanding color and rapid growth, seemed to offer possibilities as a popular and profitable pot plant for the Christmas market. With this in mind, an investigation was designed to study the interaction of root temperature, light intensity and photoperiod on the growth of the plants in the greenhouse.

PROCEDURE

Root Temperature and Light Intensity: The growth response as influenced by the interaction of root temperature and light intensity was studied by supplying the following treatments to Salvia with a 60-degree F. night temperature, 24 plants to a treatment:

1. 50° F. root temperature, 63 percent daylight
2. 50 F. root temperature, 100 percent daylight
3. 70° F. root temperature, 63 percent daylight
4. 70° F. root temperature, 100 percent daylight

Four controlled temperature tanks consisting of large insulated vats of water were constructed. Heating and refrigeration coils, connected to thermostats, controlled the temperature of the root media within a 3-degree range (Fig. 1). Earthenware crocks were suspended in the water. These crocks contained quartz sand and 0.5 Hoagland's complete nutrient solution (3).

The seeds were sown December 1, and the seedlings were moved to the crocks 40 days later. Each week the sand in which the plants were growing was drained, leached with one liter of distilled water and drained again. The drains were then closed, and one liter of nutrient solution was added and allowed to remain in the crocks.

The light intensity was reduced on the two treatments with the

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use of cheesecloth covering (Fig. 1), and the plants were grown under the existing photoperiod at East Lansing between January and March of 1954 (approximately 10-12 hours of light). A continuous recording of the light intensity in the different treatments was made with a Leeds and Northrup Seedomax type G recorder (Table 1).

Photoperiod: Salvia has been reported to produce flowers only when grown under "short days" (7). To further study the response of Salvia to photoperiod, 20 plants of the cultivar America were grown from seed planted September 15. Light periods of 16 and 8 hours were applied in 24-hour cycles, the remaining hours of each 24 consisting of darkness. The following combinations of photoperiod were used with four plants in each treatment:

1. 16-hour light period for 110 days after seeding
2. 16-hour light period for 65 days after seeding, followed by 8-hour light period for 45 days
3. 16-hour light period for 50 days after seeding, followed by 8-hour light period for 60 days
4. 16-hour light period for 35 days after seeding, followed by 8-hour light period for 75 days
5. 8-hour light period for 110 days after seeding

Fig. 1. Tanks used to grow Salvia with 50 and 70-degree F root temperature; light intensity controlled by shading to supply 100 percent and 63 percent of normal daylight.

TABLE 1—Total weekly radiations of daylight, East Lansing, Michigan

1954	Full light per week in ft. cd. hrs.	Reduced light per week in ft. cd. hrs.	Percent of full light intensity
January 11–17.....	51,700	43,900	84.9
January 18–24.....	52,800	38,500	72.9
January 25–31.....	74,200	53,300	71.8
February 1– 7.....	75,200	39,900	53.1
February 8–14.....	95,600	54,000	56.5
February 15–21.....	153,700	99,100	64.5
February 22–28.....	178,600	127,600	71.4
March 1– 7.....	159,800	71,600	44.8
March 8–14.....	140,900	66,300	47.1
Average percent of full light intensity.....	.....	.....	63.0

All of the plants were "pinched" 35 days after seeding, and only four laterals were allowed to develop per plant.

The 16-hour photoperiod was supplied by extending the normal daily period of light with 100-foot candles of incandescent light from 04:00 to 20:00 hours. The 8-hour photoperiod was supplied by reducing the normal daily period of light by moving the plants into a dark chamber between 16:30 and 08:30 hours.

DISCUSSION OF RESULTS

Root Temperature and Light Intensity: The light intensity obtained by the use of cheesecloth in this experiment ranged from 44.8 to 84.9, with the average being 63.0 percent of the total (Table 1). This fluctuation in light intensity as explained by Angstrom (1) was greater with increased cloudiness, and thus the percentage of reduction of radiation with the use of cheesecloth was reduced with increased cloudiness.

After 14 days of exposure to 50° F. root temperature, plants exhibited a chlorosis of the lower leaves, stunted growth, dark green foliage and anthocyanin development in the petioles and stems. In contrast, the plants provided with 70° F. root temperature were growing vigorously and produced bright green foliage with no anthocyanin development in the petioles and stems.

Twenty-one days later and throughout the remainder of their growth the plants at the 50° F. root temperature exhibited less evidence of chlorosis and grew more rapidly than before. The plants

exposed to 70 F. root temperature grew more rapidly, produced thicker stems, larger leaves, and greater stem elongation. (Fig. 2).

Using the height of plants as an index of growth, light intensity did not influence growth significantly. The average height varied less than 0.23 cm. on all plants grown with a 50° F. root temperature regardless of light intensity. While there was an average variation in height of 1.57 cm. on all plants grown with a 70° F. root temperature, this difference as a result of light intensity was insignificant.

The light intensity as used in this experiment did not appear to have as great an influence on plant height as seemed to be indicated by observations of Porter (5) and Went (8). Went concluded that for plants in general, intensity of the sunlight was an important factor in inhibiting stem elongation. Porter observed that light intensity was inversely related to stem elongation.

Plant height with 70° F. root temperature was on the average 28.33 cm. compared to 9.27 cm. on plants grown with 50° F. root temperature. This was in general agreement with results obtained by Roberts (6) who observed a direct correlation between the growth of aerial parts of the strawberry and an increase in root temperature.

Considering fresh weight as a measure of growth, there was a definite and consistent trend toward an increase in growth of both roots and stems with the higher root temperature and light intensity (Table 2).

Fig. 2. Interaction of root temperature on growth of Salvia 105 days after seeding. Plants from left to right received: 50° F., 63 percent light; 50° F., 100 percent light; 70° F., 63 percent light; 70° F., 100 percent light.

TABLE 2—Interaction of root temperature and light intensity on fresh weight of stems and roots in grams (average of 24 plants per treatment)

	50 degrees F.		70 degrees F.	
	Reduced light intensity	Full light intensity	Reduced light intensity	Full light intensity
Stem weight.....	2.00	3.57	25.30	36.44
Root weight.....	1.03	3.15	11.70	18.66

This production of greater fresh weight with full light intensity was in agreement with results obtained by Arthur and Stewart (2). They found that the fresh weight of stems and roots of Salvia increased as sunlight was increased from 35 to 58 to 78 to 100 percent radiation in June and July. Their results indicated that Salvia was able to utilize full radiation in June and July more efficiently than other plants used in the tests. The response of Salvia to root temperature indicated that the growth of Salvia as measured by accumulation of fresh weight was greatly inhibited at a root temperature of 50° F.

Photoperiod: The plants attained progressively less height as they were supplied with an increasing number of short days during

Fig. 3. From left to right, the plants are typical of groups which received 0 short days (SD) after 95 long days (LD), 30 SD after 65 LD, 45 SD after 50 LD, 60 SD after 35 LD, 95 SD after 0 LD. (Photographed 95 days after seeding.)

the 110 days of growth (Fig. 3; Table 3). This was in agreement with results of Murneek (5) who observed a "photoperiodic inhibition", of vegetative growth of plants that flowered when supplied with a short photoperiod. Since short dense growth was desirable in the production of attractive pot plants, this response of Salvia to short photoperiods was important.

Contrary to the results obtained by Roberts and Struckmeyer (7), flowers were produced in all treatments independent of the photoperiods supplied. A shorter period of time (98 days) was required for flower production when the plants were supplied with 20 long days followed by short days for the remainder of their growth. If the plants were supplied with all short days, or the number of long days designated in the other treatments, a longer period of time was required for flowering (Table 4). The plants supplied with 20 long days followed by short days produced more rapid growth initially than those plants supplied with all short days.

On the basis of these results, it is possible to produce flowers on a plant with relatively short laterals in the shortest period of time, by supplying 20 days of a 16-hour photoperiod followed by short days of 8-hour photoperiods until the plant is in flower.

SUMMARY

Using plant height and fresh weight to measure growth, 70° F. root temperature produced more growth of Salvia than 50° F. root

TABLE 3—Interaction of photoperiod and time on plant height

Days from seeding	L. S. D.	Short days				
		0	45	60	75	110
		Height in cm.				
50	5% 0.70 1% 0.97	2.03	1.48	1.04	0.85	0.70
70	5% 4.90 1% 5.66	12.50	10.94	5.94	5.25	4.38
90	5% 7.07 1% 9.79	28.50	21.13	15.14	13.13	12.25
110	5% 9.10 1% 12.60	41.00	31.31	26.00	20.88	22.13

TABLE 4—Interaction of photoperiod and number of days required for flowering

	L. S. D.	Short days				
		0	45	60	75	110
Days to Flowering	5% 5.10 1% 7.02	108	105	102	98	105

temperature. For greater plant height, a reduced light intensity was found to be better, but there was greater fresh weight accumulation on plants grown with full light intensity.

Flowers were produced in all of the treatments regardless of the photoperiods supplied. They were produced in the shortest period of time when the plants were supplied with 20 days at a 16-hour photoperiod followed by short days of 8-hour photoperiods for 78 days when the plants were in flower.

Salvia plants attained progressively less height as they were supplied with an increasing number of short days during the 110 days of growth.

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THE EFFECT OF TEMPERATURE CHANGES ON TRACTOR TIRE INFLATION PRESSURES

By WALTER M. CARLETON[1]

DEPARTMENT OF AGRICULTURAL ENGINEERING

PREVIOUS INVESTIGATIONS[1] have shown the effect of temperature changes on certain tractor tires when filled completely or partially with liquid. The results reported here include tests on air-filled tires in addition to tests on tires partially and completely filled with liquid. The objective of the tests was to determine the effect of air temperature extremes on the inflation pressure.

Six rear and two front tractor tires were inflated and successively subjected to temperatures of 110 , 40° and 0° F. (Table 1.)

Duplicate tests were made by using two tires for each test condition. Dial gauges were fitted with special attachments in order that

TABLE 1

Tire designation	Tire size	Tire fill	Filling pressure p.s.i. at room temperature of 70°F.
S1	6:00—16	Air	26
S2	6:00—16	Air	26
100–1	11 x 28	100% liquid fill*	12
100–2	11 x 28	100% liquid fill*	12
80–1	11 x 28	Liquid to top of rim	12
80–2	11 x 28	Liquid to top of rim	12
0–1	11 x 28	Air	12
0–2	11 x 28	Air	12

*Calcium Chloride Solution.

[1]Sauve, E. C., and E. G. McKibben (Aug. 1945). Studies on the Use of Liquid in Tractor Tires. Mich. Agr. Exp. Sta. Quart. Bul.

Acknowledgements: Credit is due Mirza Shustary, Senior Agricultural Engineering student who conducted preliminary tests and to James Cawood, Research Laboratory Foreman, who gave material assistance. Tires and tubes for the tests were supplied through the courtesy of Ferguson Division, Massey-Harris-Ferguson, Inc., Detroit, Michigan.

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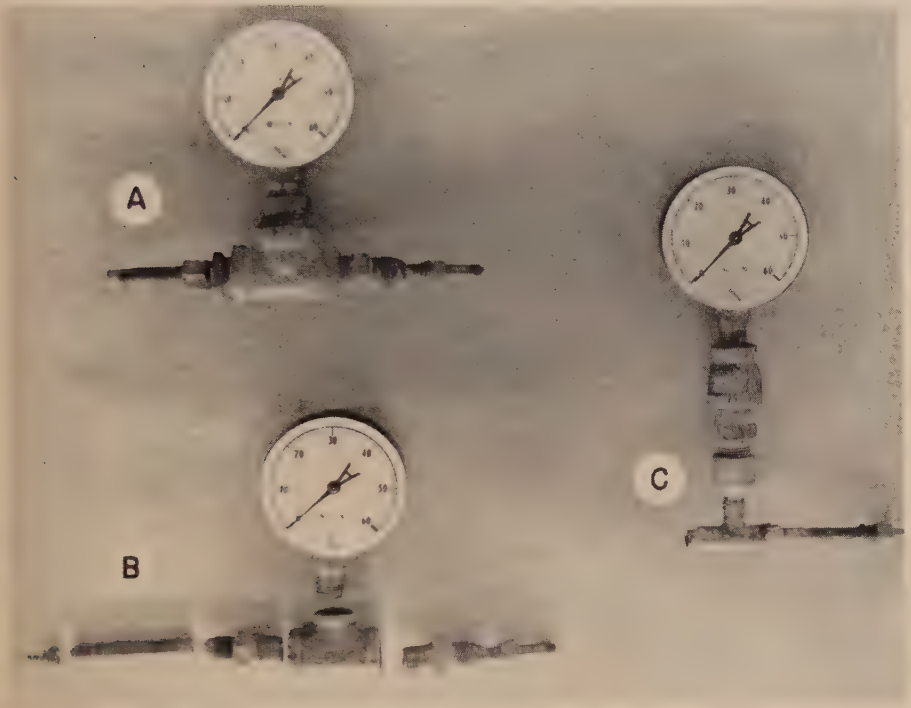

Fig. 1. Air pressure gauge and attachments. (A) Assembled rear tire unit, (B) Disassembled rear tire unit, (C) Assembled front tire unit.

the pressure could be read without releasing any air or liquid from the tires during the test. (Fig. 1).

Careful soldering and assembly were necessary to prevent air leaks, particularly for the front tire units where it was necessary to solder onto and make a hole through the top of an ordinary valve cap.

A walk-in refrigerator was used for a 40° F. test room, a walk-in freezer for the 0° F. test room, and a small insulated room was heated by an electric circulating unit to maintain a temperature of approximately 110° F. Room temperature was maintained at approximately 70° F. by thermostatically-controlled steam radiators.

Average pressures for the two tires of each test at each temperature are plotted in Fig. 2.

Observations during the tests indicated that the pressure changes due to air temperature were completed in the first 20 to 24 hours regardless of whether the tire was air or liquid filled. Temperatures

higher than 110° F. would be possible under actual conditions on hot sunny days, particularly in states farther south than Michigan.

From the results of these tests as plotted in Fig. 2:

(1) A total variation of 9 p. s. i. occurred in the 6:00 x 16 tires when the temperature was varied from 0 to 110° F.

(2) A total variation of 16 p. s. i. occurred in the 100 percent liquid filled 11 x 28 tires when the temperature was varied from 0 to 110° F.

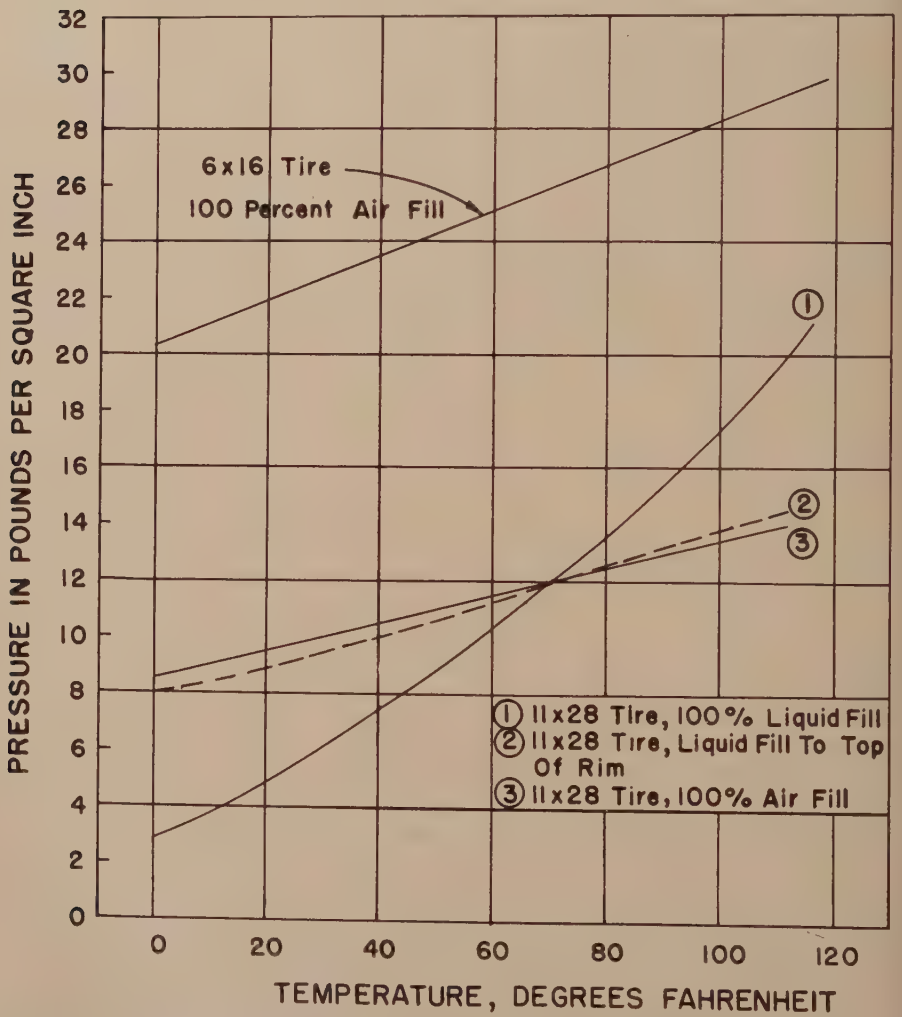

Fig. 2. Change of inflation pressure with change in temperature. Initial filling temperature was 70° F.

(3) The 11 x 28 tires filled with air had a much smaller range of pressure fluctuation with the extremes of temperature than did the liquid filled tires.

Information from tire manufacturing organizations[2,3] indicates that excessive variations in the pressure may increase tire wear and decrease tire life. The farmer will do well to check his tractor tire pressures at regular intervals and most certainly at the start of the winter and summer seasons. A tractor operated tire pump and a good tire gauge will make it easier to maintain proper tire inflation.

[2]The Rubber Mfgrs. Assoc. "How to Get Extra Service from Farm Tires", undated.
[3]Sohl, R. W. "Effects of Inflation Pressure on Traction and Tread Wear of Tractor Tires". Paper presented at meeting of American Society of Agricultural Engineers, Minneapolis, June 1954.

FUNGICIDE-INSECTICIDE COMBINATION SEED TREATMENT OF BEANS FOR THE CONTROL OF DAMPING-OFF AND SEED CORN MAGGOT[1]

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COMMERCIAL APPLICATION of seed treatment chemicals to beans to reduce damage from seed decay and seed insects is now becoming a standard practice in many bean producing areas. Growers who have been using fungicide seed treatments are convinced that their use is beneficial. Now the additional protection given by an insecticide should make the combination treatment a part of the growers' program every year.

Since bean varieties were known to differ in susceptibility to damping-off and in their response to protection from fungicides (1, 3), it was decided to investigate the combination treatments on several varieties in Michigan. Investigators in New York (4) made extensive tests of lindane, chlordane, aldrin, dieldrin and other insecticides in conjunction with a fungicide (Arasan) on lima bean seed. Less extensive tests were made on other types of bean.

On the basis of these results, investigations were begun in the greenhouse during the winter of 1951-52[3] and continued in the field in 1952 and 1953. Both dry bean and garden or canning varieties were included. The ultimate purpose of the study was to determine the best possible combinations of insecticide and fungicide to protect bean seed and at the same time be satisfactory for large scale commercial application.

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MATERIALS AND METHODS

The most important dry bean varieties of Michigan were used throughout the tests. These include Michelite (Navy pea bean), Michigan Dark Red Kidney, and Michigan Cranberry bean. Round Pod Kidney Wax and Fordhook 242 lima bean were used to represent the garden and the lima bean varieties because they are extremely susceptible to damping-off and seed decay. The variety Ranger, another garden variety, was used in one test. All field experiments were designed for statistical analysis of the data.

Two phases of investigation were undertaken. The first included tests to determine amounts of various insecticides that could be used safely to treat bean seed. The preliminary tests were made during the winter of 1951-52 in the greenhouse, and included the insecticides lindane and dieldrin and the fungicide captan. The treated seed was planted in shaded flats or pots and grown at air temperatures of 60°, 70° and 80° F. At the conclusion of the experiments, when the seedlings were beyond danger of damping-off, notes were made on emergence, number of healthy seedlings, general vigor, and height of plant when this information appeared to be significant. A comparison of the stands of healthy seedlings was generally the most useful and practical method for evaluating the effects of the seed protectants.

The second phase of the investigations included the field studies. These experiments were designed so that each replicated plot was 25 feet long. Notes were taken on stands of healthy plants, presence of seed-corn maggots, and general appearance at a time when the plants were fully emerged and past the danger of succumbing to disease and seed-corn maggot attacks associated with the early seedling stages. This period was generally from 3 to 4 weeks after planting.

Thirteen experiments were conducted in several locations in Michigan in 1952. The fungicides used were 75 percent thiram (Arasan SF-X), 75 percent captan (Orthocide 75), 50 percent dichlone (Phygon XL), and a 30 percent liquid carbamate mixture (Vancide 51). The insecticides were aldrin, chlordane, dieldrin, and lindane, all in the form of wettable powders. These materials were used as slurries, alone and in combination, on several varieties of beans. In four of the experiments, dry applications were also used where feasible.

Sixteen separate plantings were made at East Lansing, Michigan in 1953 to compare fall-treated with spring-treated seed. The fall

and spring-treated seeds were planted side-by-side in split plot design. Three varieties and four planting dates were used. The insecticides lindane, dieldrin, and heptachlor and the fungicides dichlone, thiram, and captan were compared alone and in combination using the slurry method of application. Details of the experimental field plots for the 1952 and 1953 field experiments are given in Table 1.

Through the efforts of the field staff of the Wallace and Morley Company, Bayport, Michigan, cooperation was obtained with 15 farmers located in Huron county, Michigan. Seed of the variety Michelite was treated with a proprietary combination of thiram and lindane (duPont I and D) or captan and lindane (Ortho Seed Guard) by the company. Each treatment was replicated eight times at three locations on each farm.

The seedings, made by the cooperating farmers, varied from 28 to 50 lbs. per acre. Due to the greater friction of the treated seeds in the drills, they had approximately 10 percent lower seeding rate than

TABLE 1—Field plantings 1952 and 1953. Date of planting, variety, location, number of treatments, number of replications, seeds per replication for each experiment

Experiment number	Date of planting	Variety*	Location	Number of treatments	Number of replications	Number of seeds per replication
38.....	5/ 5/52	Kidney...	East Lansing, Mich.....	44	5	80
39.....	5/15/52	Cranberry.	East Lansing, Mich.....	44	5	80
40.....	5/17/52	Lima.....	East Lansing, Mich.....	44	5	80
41.....	5/17/52	Wax.....	East Lansing, Mich.....	44	5	80
42.....	5/16/52	Lima.....	Ferry Morse Seed Co., Rochester, Mich.	25	6	80
43.....	5/16/52	Wax.....		25	6	100
44.....	5/20/52	Ranger....	Stokely Canning Co., Scottville, Mich.	25	6	120
45.....	5/20/52	Lima.....		25	6	80
46.....	6/10/52	Kidney...	East Lansing, Mich.....	25	6	80
47.....	6/10/52	Cranberry.	East Lansing, Mich.....	25	6	80
48.....	5/27/52	Michelite..	Stuart English, Poseyville, Mich.	25	6	150
49.....	5/27/52	Michelite..	Harry Lehr, Poseyville, Mich....	25	6	150
50.....	5/27/52	Michelite..	Earl Witkowski, Poseyville, Mich.	25	6	150
61.....	5/16/53	Wax.....	East Lansing, Mich.....	16	4	100
61.....	5/16/53	Michelite..	East Lansing, Mich.....	16	4	100
61.....	5/16/53	Kidney...	East Lansing, Mich.....	16	4	100
61.....	5/20/53	Wax.....	East Lansing, Mich.....	16	4	100
61.....	5/20/53	Michelite..	East Lansing, Mich.....	16	4	100
61.....	5/20/53	Kidney...	East Lansing, Mich.....	16	4	100
61.....	5/26/53	Wax.....	East Lansing, Mich.....	16	4	100
61.....	5/26/53	Michelite..	East Lansing, Mich.....	16	4	100
61.....	5/26/53	Kidney...	East Lansing, Mich.....	16	4	100
61.....	6/ 1/53	Wax.....	East Lansing, Mich.....	16	4	100
61.....	6/ 1/53	Michelite..	East Lansing, Mich.....	16	4	100
61.....	6/ 1/53	Kidney...	East Lansing, Mich.....	16	4	100

*Kidney = Mich. Dark Red Kidney; Cranberry = Mich. Cranberry; Lima = Fordhook 242 lima bean; Wax = Round Pod Kidney Wax; Ranger = Ranger green beans; Michelite = Michelite Navy pea beans.

TABLE 2—Field experiments in Huron County, 1953. Plantings in cooperation with Wallace and Morley Co.

Cooperator	Seeding rate lb./acre	Previous cropping	Date planted	Date recorded
1. John Tanton.....	40	Beans, Rye.....	5/28	6/12
2. Grover Lauren.....	29	Sweet Clover.....	6/9	6/19
3. Claude Black.....	45	.....	6/9	6/18
4. Frank Roberts.....	50	Mammoth Clover.....	....	6/16
5. Herman Krohn.....	35	.....	6/18	7/3
6. Stanley Lam.....	40	Sweet Clover.....	6/9	6/18
7. Noel Perry.....	35	Alfalfa, Beans.....	6/20	7/3
8. Sam Musky.....	..	Red Clover.....	6/12	6/19
9. Kusserman Brothers.	40	Beets.....	6/18	7/2
10. John Crosby.....	40	Clover.....	....	6/20
11. Foster Hickey.....	40	Sweet Clover.....	6/2	6/18
12. Ernest Fritz.....	38	Sweet Clover.....	....	6/29
13. Jan Kaiser.....	30	Sweet Clover.....	6/2	6/16
14. Fred Brandenberg....	40	Corn.....	5/29	6/11
15. Walter Fiebig.....	40	Sweet Clover.....	6/1	....

the untreated ones. No allowance was made for this in making seedling counts, and the stands in the treated plots, therefore, actually represented seedlings from fewer seeds per unit row than was the case in the untreated controls.

Particular note should be made of this where the difference due to treatment might appear insignificant otherwise. Notes were taken on the number of healthy and baldhead (caused by insect injury and other injuries) plants per 25 feet of row 10 to 14 days after planting. The cooperator, previous cropping, and date of planting are given in Table 2.

EXPERIMENTAL RESULTS

The Effect of Lindane on Seedling Development at Various Greenhouse Temperatures

Lindane is known to produce abnormal cell development when it comes in contact with meristematic (growing) tissues (2, 5). It is also known to be injurious to some germinating bean seeds at low temperatures, particularly when used as a seed protectant in the absence of a fungicide (4). Because of this toxic effect of lindane, several experiments were conducted in the greenhouse to determine the amounts of lindane which could be used safely on bean seeds. Part of results showing the effects of lindane on germination of the Michelite

bean grown at 60° and 80° F. are presented graphically in Figure 1. The effects of lindane on the number of healthy plants emerging at 60°, 70°, and 80° F. are presented in Table 3.

The tests showed that lindane used alone, even at the lowest rate of 1 oz. of the 25 percent material, reduced the vigor of the plants and appeared to render them more susceptible to attack by damping-off and seed decay organisms. However, when the insecticide was mixed with a suitable fungicide (captan in these experiments) reduction in vigor was masked. In fact (at 60° F.) as the quantity of lindane

TABLE 3—The influence of soil temperature and treatment of seeds with various combinations of fungicide and insecticide on the percentage of healthy seedling emergence of Round Pod Kidney Wax beans, and Michelite pea beans. Summary of five greenhouse plantings 1951-52

LINDANE COMBINATIONS

Treatment	60°F.			70°F.	80°F.
	R.P.K.[1]	Mich.[2]	Mich.[3]	Mich.[3]	Mich.[3]
1. Control	22	40	16	85	82
2. Captan 50%—2 oz./100 lb.	85	53	58	87	93
3. Lindane 25%—1 oz.	9	26	12	80	89
4. Lindane 25%—2 oz.	4	29	16	68	87
5. Lindane 75%—1 oz.	11	32	5	70	89
6. Lindane 75%—2 oz.	7	31	9	77	87
7. Lindane 25%—1 oz. + Captan 50%.	67	52	58	87	84
8. Lindane 25%—2 oz. + Captan 50%.	70	53	55	81	90
9. Lindane 75%—1 oz. + Captan 50%.	73	71	68	84	87
10. Lindane 75%—2 oz. + Captan 50%.	62	52	51	92	93

DIELDRIN COMBINATIONS

	Mich.[4]	Mich.[5]	Mich.[3]
1. Control	65	34	66
2. Captan 50%— 2 oz./100 lb.	78	74	90
3. Dieldrin 50%— ½ oz.	69	35	82
4. Dieldrin 50%— 1 oz.	62	25	83
5. Dieldrin 50%—1½ oz.	64	33	64
6. Dieldrin 50%— 2 oz.	63	24	80
7. Dieldrin 50%— ½ oz. + Captan 50%.	81	73	83
8. Dieldrin 50%— 1 oz. + Captan 50%.	86	70	82
9. Dieldrin 50%—1½ oz. + Captan 50%.	83	83	91
10. Dieldrin 50%— 2 oz. + Captan 50%.	82	80	89

[1] 5 replications, 30 seeds each, in flats; [2] 15 replications, 13 seeds each, in pots; [3] 5 replications, 40 seeds each in flats; [4] 15 replications, 13 seeds each, in pots; [5] 5 replications, 40 seeds each, in flats.

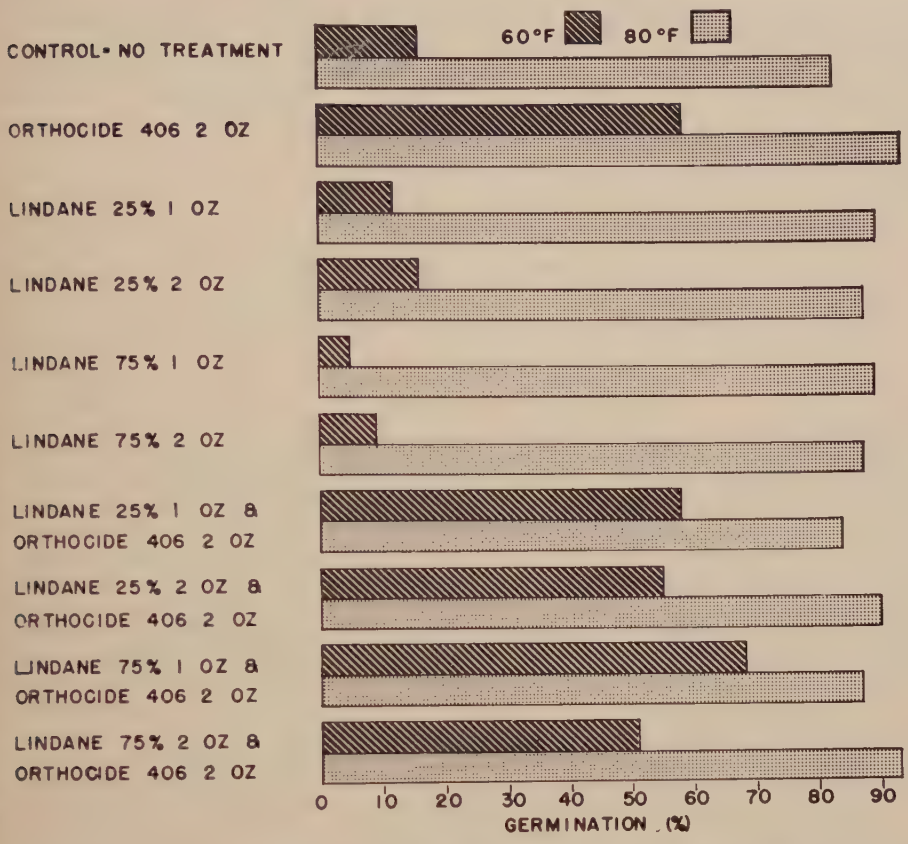
60°F
80°F
CONTROL- NO TREATMENT
ORTHOCIDE 406 2 OZ
LINDANE 25% 1 OZ
LINDANE 25% 2 OZ
LINDANE 75% 1 OZ
LINDANE 75% 2 OZ
LINDANE 25% 1 OZ &
ORTHOCIDE 406 2 OZ
LINDANE 25% 2 OZ &
ORTHOCIDE 406 2 OZ
LINDANE 75% 1 OZ &
ORTHOCIDE 406 2 OZ
LINDANE 75% 2 OZ &
ORTHOCIDE 406 2 OZ
0 10 20 30 40 50 60 70 80 90
GERMINATION (%)

Fig. 1. Percentage stands of Michelite beans treated with various combinations of lindane insecticide and captan 50 percent fungicide at 60 and 80 degrees F. Note the protective action of the fungicide on insecticide treated seeds at the lower temperature.

was increased in combination with captan, up to 1 oz. of 75 percent, average plant height also increased.

Different reactions were noted on the plants grown at 70° and 80° F. There was little or no seed decay or damping-off at these temperatures. At 70° F., there was only slight evidence of toxicity when the seeds were treated with lindane alone, and at 80° F., there was no retardation of growth from the lindane treated seeds. At the higher temperatures, the greatest stimulation to plant development occurred when 1 oz. or more of the 75 percent lindane was applied to the seed in combination with captan (Fig. 2). Each plant was representative of a treatment and was selected to show the magnitude of

the differences between the treated plots. These tests showed that the maximum amount of lindane used with a fungicide should not exceed 1 oz. of the 75 percent material (wettable powder) per 100 lbs. of seed for safety at both low and high germination temperatures.

The Effect of Dieldrin on Seedling Development at Various Greenhouse Temperatures

Trials similar to those described for lindane were made using dieldrin. The results are summarized in Table 3. It is obvious that the reactions are quite different from those caused by lindane. Dieldrin

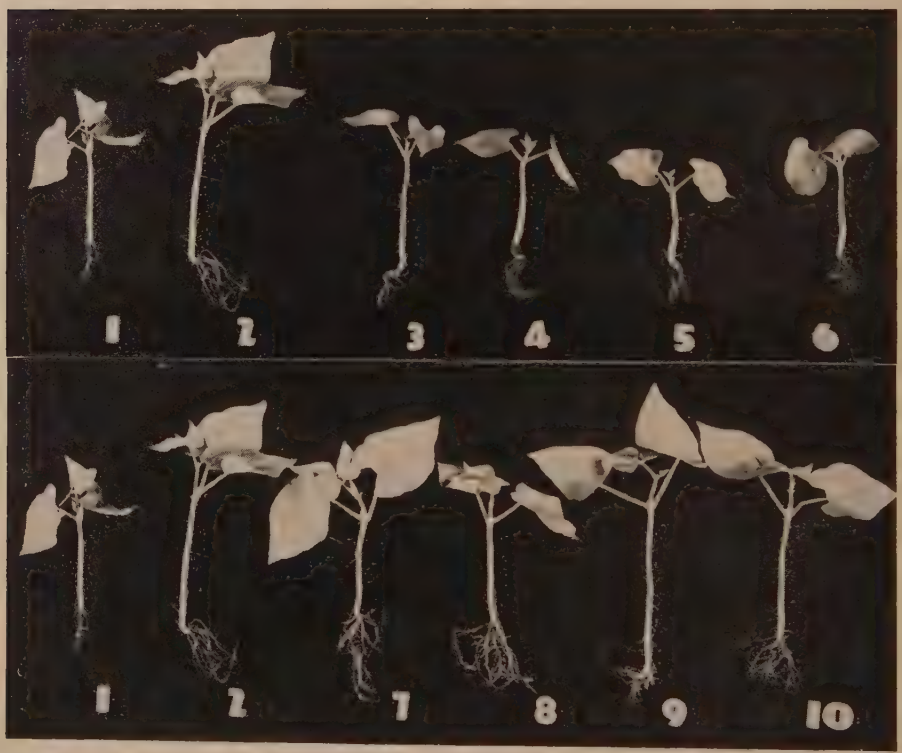

Fig. 2. Growth retardation effect of lindane seed treatment of Michelite beans at 60° F. (1) Control, (2) captan 50 percent – 2 oz./100 lbs. seed, (3) lindane 25 percent – 1 oz., (4) lindane 25 percent – 2 oz., (5) lindane 75 percent – 1 oz., (6) lindane 75 percent – 2 oz., (7) lindane 25 percent – 1 oz. plus captan 50 percent – 2 oz., (8) lindane 25 percent – 2 oz. plus captan 50 percent – 2 oz., (9) lindane 75 percent – 1 oz. plus captan 50 percent – 2 oz., and (10) lindane 75 percent – 2 oz. plus captan 50 percent – 2 oz. Plants representative of the average for each treatment.

TABLE 4—The effect of fungicide-insecticide, seed treatments, and of the fungicides and insecticides alone on percentage stands of four varieties of beans. Four locations in Michigan, 1952

Treatment	Round Pod* Kidney Waxbean Exp. 43	Ranger green bean Exp. 44	Dark red Kidney bean Exp. 46	Michelite Navy pea bean Exp. 49
1. Aldrin 25%—1 oz./100 lb.	54	13	89	89
2. Chlordane 50%—1 oz.	44	12	84	84
3. Dieldrin 25%—1 oz.	51	12	85	90
4. Lindane 75%—1 oz.	41	7	89	84
5. Thiram 75%—3 oz.	50	46	90	77
6. Captan 75%—2 oz.	59	47	87	76
7. Dichlone 50%—4 oz.	50	49	87	83
8. Liquid mixture 30%—6 oz.†	50	39	89	74
9. Aldrin + thiram	56	50	91	89
10. Aldrin + captan	64	48	94	88
11. Aldrin + dichlone	59	49	87	91
12. Aldrin + liquid mixture	53	38	89	86
13. Chlordane + thiram	60	49	90	88
14. Chlordane + captan	64	52	90	88
15. Chlordane + dichlone	60	49	92	85
16. Chlordane + liquid mixture	52	42	87	80
17. Dieldrin + thiram	62	52	89	94
18. Dieldrin + captan	63	47	92	91
19. Dieldrin + dichlone	57	52	94	90
20. Dieldrin + liquid mixture	55	42	92	88
21. Lindane + thiram	55	47	94	89
22. Lindane + captan	55	49	89	92
23. Lindane + dichlone	51	42	91	88
24. Lindane + liquid mixture	48	40	89	84
25. Control—no treatment	42	13	87	81
L.S.D. 5% level	8	8	5	7
L.S.D. 1% level	11	11	6	9

*See Table 1 for number of seeds per replication experiments 43, 44, 46 and 49.
†Vancide 51.
Numbers in bold face indicate treatment statistically superior (5% level) to the control.

alone, at the concentrations used in these experiments, did not predispose the germinating seeds to damping-off and seed decay as did lindane.

Even though stands of seedlings in the dieldrin plots were poor in comparison to captan, they were not below the controls at any temperature. There was no evidence of any stimulating effect on vigor

when it was applied together with captan. The results indicated that dieldrin could be used on bean seeds safely at a concentration of 2 oz. of the 50 percent material or its equivalent per 100 lbs. of seed.

Field Experiments – 1952

The results from 4 of the 13 experiments conducted in 1952 (Nos. 43, 44, 46 and 49) are presented in Table 4. For various reasons, such as poor germination, wash-outs and lack of either severe damping-off or seed-corn maggot infestation, the results of the remainder are not included.

Inspection of Table 4 shows that most fungicide and fungicide-insecticide combination treatments were beneficial to damping-off susceptible varieties, i.e., Round Pod Kidney Wax and Ranger. The varieties Red Kidney and Michelite, more resistant to damping-off and seed decay, were also benefited significantly by some treatments, notably thiram, captan and dichlone combinations with aldrin, dieldrin and lindane. There were significant amounts of seed-corn maggot damage in the Michelite experiment (No. 49) since two insecticides, aldrin and dieldrin, gave statistically significant protection while the fungicides alone failed to do so. Chlordane and lindane were ineffective when used alone, however.

When the averages of all four experiments were compared, the best combinations were dieldrin with dichlone, thiram or captan. The validity of such a method of ranking may be questioned since the bean varieties behave somewhat differently in respect to damping-off and seed decay and even as to sensitivity to the chemicals used.

For practical purposes, it would be more accurate to choose the best few combinations for each variety used. In this case they were: aldrin, chlordane, or dieldrin with thiram or captan for the variety Round Pod Kidney Wax; dieldrin, chlordane, or aldrin with thiram, dichlone or captan for Ranger; aldrin, lindane, dieldrin, or chlordane with captan, thiram, dichlone or Vancide for Red Kidney; dieldrin, lindane, or aldrin with thiram, captan, or dichlone for Michelite. The materials listed above in each case are in order of effectiveness.

Field Experiments – 1953

The 1953 field work consisted of two series of experiments. One series was conducted at East Lansing and the other supervised by the Wallace and Morley Co. field staff. Those at East Lansing were designed to test the effect of storage of treated seed on stand, the

TABLE 5—The effects of fungicide-insecticide seed treatments, and of the fungicides and insecticides alone on percentage stands of three bean varieties planted at four different dates. East Lansing, Michigan, 1953

Treatment	Round Pod Kidney Wax planted				Michelite Pea Bean planted				Dark Red Kidney planted			
	May 16	May 20	May 26	June 1	May 16	May 20	May 26	June 1	May 16	May 20	May 26	June 1
1. Lindane 25%—2 oz.	31.6*	58.5	71.9	81.7	12.7	71.5	**81.7**	81.0	29.5	59.9	**70.1**	**64.7**
2. Dieldrin 50%—1 oz.	17.7	38.2	67.4	77.0	8.1	67.9	**85.1**	82.2	19.9	57.5	**68.2**	61.5
3. Heptachlor 25%—2 oz.	17.6	41.5	66.7	82.6	9.4	65.9	78.1	79.7	22.4	52.5	**70.0**	**65.1**
4. Control — sticker only	26.1	49.2	71.9	79.0	17.2	57.1	72.4	76.4	26.6	54.1	61.9	53.4
5. Dichlone 50%—3 oz.	30.5	**78.2**	**82.6**	86.0	**36.7**	69.7	69.6	76.0	28.9	66.0	**67.7**	58.9
6. Thiram 75%—3 oz.	**47.1**	**80.0**	**85.5**	88.6	**39.7**	69.2	75.6	77.7	17.9	56.9	63.0	53.7
7. Captan 75%—2 oz.	**46.1**	**77.0**	**90.5**	88.9	**39.9**	73.5	69.0	70.2	31.1	66.0	**68.2**	**63.9**
8. Lindane and dichlone	38.7	**73.1**	**87.4**	85.9	**40.9**	74.7	73.9	81.2	39.7	59.4	66.9	55.2
9. Lindane and thiram	**53.2**	**79.6**	**90.4**	88.6	**34.6**	**76.5**	**80.5**	79.7	32.2	67.2	**70.9**	**64.6**
10. Lindane and captan	**44.1**	**79.7**	**88.4**	85.0	**49.0**	**75.1**	**80.2**	79.2	39.0	65.6	**72.2**	**68.9**
11. Dieldrin and dichlone	**45.0**	**77.6**	**86.4**	88.2	29.0	**79.0**	**83.0**	80.1	31.9	64.0	**69.1**	61.4
12. Dieldrin and thiram	**43.2**	**79.7**	**91.2**	88.1	28.9	**79.5**	**84.2**	79.2	27.1	65.0	**73.4**	**65.7**
13. Dieldrin and captan	**54.4**	**80.1**	**87.8**	87.9	**41.4**	**77.9**	**82.5**	77.5	35.4	65.0	**72.2**	**67.6**
14. Heptachlor and dichlone	30.5	**76.4**	**87.9**	88.0	**32.1**	**76.1**	**79.9**	77.0	33.7	58.9	**68.6**	**63.7**
15. Heptachlor and thiram	**45.5**	**77.5**	**89.1**	84.9	**47.6**	**80.0**	**78.6**	78.5	34.6	62.5	**71.4**	**65.6**
16. Heptachlor and captan	**49.8**	**80.7**	**89.7**	87.9	**49.6**	**78.7**	**81.0**	79.1	31.5	62.5	**67.4**	**62.5**
L.S.D. at 5% level	14.7	20.4	9.0	....	12.3	18.0	6.1	....	....	....	5.5	8.6
L.S.D. at 1% level	19.7	27.3	12.1	....	16.5	24.1	8.2	....	....	....	7.4	11.5

*Average of 8 rows in 4 replications.

Numbers in bold face indicate treatment statistically superior to control L.S.D. 5% or more.

effect of time of planting, and the effect of the treatments themselves on emergence of several bean varieties. When emergent data were taken, it was apparent that there were no consistent differences between fall and spring treatments; hence the data were combined for analysis (Table 5).

Round Pod Kidney Wax responded favorably to fungicide and combination treatments in the first three plantings, but was not benefited in the last planting because of the low incidence of damping-off and seed decay in the controls. Insecticides alone did not protect this variety. Michelite responded to fungicide and combination treatments in the first planting. In the second planting, only the combinations were statistically effective, but it can be seen that either fungicide or insecticide gave some slight increases. Apparently, both damping-off and seed-corn maggot were factors at this time.

At the time of the third planting (May 26), damping-off was less serious, as was shown by the higher stand in control plots; but seed-corn maggot injury was still evident. Statistically significant improvement of emergence was obtained with lindane or dieldrin alone, whereas the fungicides alone were ineffective.

On June 1, when the fourth planting was made, the situation was again changed. Emergence was high and none of the treatments was significantly better than the control. Red Kidney beans were not sufficiently protected by any of the treatments to give better stands than the control in plantings 1 and 2. Even in the third and fourth plantings, the results were slightly erratic, but the evidence indicates that the seed-corn maggot probably was more responsible for reducing stand than were damping-off and seed decay.

The results of these trials, as well as those obtained in 1952, indicate the desirability of treating bean seed with both an insecticide and a fungicide. The soil and climatic conditions varied for the four plantings, but the varieties responded differently also. It is not to be assumed, simply because Round Pod Kidney Wax did not respond favorably to insecticide treatments, that they are not useful on this variety. Seed-corn maggots were not a problem in the four plantings of this variety.

The best treatments, using total emergence as a criterion, for the variety Round Pod Kidney Wax were thiram and captan alone or in combination with dieldrin; for the variety Michelite, captan or thiram in combination with heptachlor, lindane or dieldrin; for Dark Red

TABLE 6—Average stands of beans treated with two combinations of fungicide-insecticide seed treatment. Ten farm locations in Bay county, Michigan, 1953

Grower	Average stands of* normal plants			Least significant difference (L.S.D.)	
	Check	T-L†	C-L	5%	1%
1. John Tanton	66.9	61.8	**75.3**	3.1	4.2
2. Grover Lauren	57.3	**66.8**	56.8	4.0	5.4
3. Claude Black	70.9	78.5	76.3	5.4	7.2
4. Frank Roberts	86.9	99.5	91.5	6.6	8.9
5. Herman Krohn	45.7	**56.5**	50.1	3.1	4.2
6. Stanley Lam	63.5	62.0	**67.8**	3.9	5.2
7. Noel Perry	48.8	59.2	56.4	4.5	6.1
8. Sam Musky	116.9	**217.6**	189.1	4.0	6.0
9. Kusserman Brothers	70.5	71.0	68.2	N.S.	N.S.
10. John Crosby	59.2	73.8	73.9	3.5	4.7

*Average of 8 replications in three locations on each farm.
Variety Michelite
†T-L (thiram-lindane) C-L (captan-lindane).
Numbers in bold face indicate that the treatment was significantly superior (5% level) to the other treatment as well as the control.

Kidney, captan or thiram in combination with either lindane or dieldrin followed closely by thiram and heptachlor.

Ten of the 15 Wallace and Morley Company plantings were sufficiently controlled to allow analysis of the stand data. Data on numbers of baldhead plants (all causes) were also taken, but could not be analyzed because of the small numbers involved. The data for the first 10 experiments were analyzed and are shown in Table 6. Both thiram-lindane and captan-lindane combinations gave significantly better stands than the controls in eight of the experiments. In one experiment, only thiram-lindane was effective and in the other neither was effective. In four of the experiments, thiram-lindane appeared to be statistically superior to captan-lindane, but in two others, the captan-lindane combination was the superior.

The data on numbers of baldhead plants did not correlate well with those for emergence. In general, there were more such plants in the heavier seeded plots. In the absence of control plots with fungicide or insecticide alone, it was impossible to determine which was the most valuable component of the treatment mixture. Others have shown (1, 3 and 4), however, that the fungicides may be used alone

but not the insecticides. For relative certainty in protecting against both fungus and insect attack, the use of some good combination seed treatment is imperative.

SUMMARY

Two years' field and greenhouse work on fungicide-insecticide seed treatment for controlling seed-corn maggot and seed decay or damping-off organisms of beans are described. In ordinary cases, the fungicide component of the mixtures gives more consistent protection, but an insecticide is necessary when there is danger of seed-corn maggot infestation. Insecticides used alone were usually ineffective, especially at lower soil temperatures when damping-off is most severe and injury from the insecticide is also most severe.

All of the insecticides used—aldrin, lindane, dieldrin, chlordane and heptachlor—gave satisfactory results in one or more of the trials. The two most consistent materials, lindane and dieldrin, appeared to be nearly equal in effectiveness. Heptachlor, replacing chlordane, promises to rank well in future tests.

There seems little doubt that both thiram and captan compounds are equal in effectiveness. In some trials, one was superior, but on the average there was little difference between them. Dichlone, a very good seed protectant, was not as effective as the other two fungicides. This chemical caused some seed injury, resulting occasionally in reduced plant vigor. The liquid mixture (Vancide 51) was not as effective as thiram, captan or dichlone. It is a very safe material to use on seeds, however, and gives significant increases in stand when used at high enough rates.

Cooperative tests in farmers' fields demonstrated the value of thiram-lindane and captan-lindane treatments in large scale plantings. Significant improvements in stands were obtained, even with approximately 10 percent lower seeding rates caused by friction of the treated seeds in the drills.

The effective rates for commercial use in slurry treaters are: Insecticide—1 ounce of the 50 percent material (as wettable powder), fungicide—2 or 3 ounces of the 75 percent material (wettable powder) per 100 lbs. of seed.

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USE OF THE LOUNGE AREA BY DAIRY COWS IN LOOSE-HOUSING WHEN SELF-FED ROUGHAGE IN AN OUTSIDE LOT

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LITTLE INFORMATION on the activities of dairy cows in loose-housing is available, although such studies would provide clues to desirable management practices. A general description of dairy cow activities in loose-housing when roughage was self-fed in the lot area has been presented in an earlier paper[2]. The present report contains a more detailed analysis of lounge area traffic and the effectiveness of self-feeding hay and silage or hay alone in reducing it to a minimum. Particular attention has been given to the value of outside feeding in encouraging cows to vacate the lounge area immediately after milking and to use the lounge only when resting.

METHODS AND MATERIALS

A series of six 24-hour observations on a herd of Brown Swiss cows maintained in a quonset-type steel loose-housing barn located on the Michigan State College farm were made between November 1, 1952 and March 30, 1953. The first 24-hour period was obtained by combining three 8-hour observations during successive portions of different days. The subsequent observations covered 24 consecutive hours. During these periods, a check of the location and activity of each cow was made at 10-minute intervals. The following activities were recorded: eating hay and silage, loitering in the yard and lounge, and resting in the yard and lounge areas.

The cows had free access to hay and a self-feeding, upright silo containing corn silage during the first three observations. During the second three observations, the cows were self-fed chopped alfalfa-

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[2]Lewis, R. C. and J. D. Johnson (1954). Observations of dairy cow activities in loose-housing. Jour. Dairy Sci., 37: 269-275.

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brome hay as the only roughage. Concentrates were fed in the milking room to cows in lactation while dry cows were fed in a trough located in the paved lot. The cows were milked at approximately 6 a. m. and 6 p. m.

RESULTS AND DISCUSSION

Activities of cows immediately after milking. The data summarized in Table 1 show that, contrary to the opinion held by many, a large percentage of the cows return directly to the lounge area after being milked. In this barn, the exit from the milking room is located just inside the exit from the lounge to the lot area. Thus it was convenient for the cows to go outside without returning to the lounge. In spite of this, 72 percent of the cows receiving hay and silage and 61 percent of those on hay alone returned to the lounge area where they loitered and rested for approximately an hour after the morning milking.

After the evening milking, 42 and 36 percent of the cows returned to the lounge when fed hay plus silage and hay alone respectively. These cows went into the yard at the end of three-fourths of an hour when on the hay-silage ration but remained in the lounge for over three hours when fed hay as the only roughage.

A larger percentage of the cows went immediately into the paved lot when hay was fed than when both hay and silage were provided. After the morning milking, the cows receiving hay alone remained in

TABLE 1—Movement of cows in loose-housing immediately after milking when roughage and water were supplied in the paved lot

	When self-fed roughage was			
	Hay and silage		Hay alone	
	A.M.	P.M.	A.M.	P.M.
Total number of cows observed	29	38	38	45
Returned directly to lounge				
Number of cows	21	16	23	16
Minutes remained in lounge (average)	64	46	60	193
Went to yard and loitered there				
Number of cows	4	8	10	14
Minutes loitering (average)	18	19	49	26
Went to yard and ate roughage				
Number of cows	4	14	5	15
Minutes of continuous eating (average)	18	36	74	54
Minutes before re-entering lounge (average)	118	86	235	61

the lot for an average of nearly four hours while those fed hay and silage returned to the lounge in about two hours. However, after the evening milking, the cows getting both roughages stayed in the lot for about 1.5 hours, while those on hay re-entered the lounge after an hour.

Differences in weather conditions between the various observation dates appeared to have had no part in affecting these movements of the cows. All of the observations were made during the winter under similar weather conditions.

There is little reason to doubt that outside feeding does reduce the amount of time cows spend within the lounge area. However, during the winter months, when morning milking is often completed before daylight and it may be dark by the time chores are done in the evening, a large percentage of the cows will return to the lounge area to rest or loiter after they have been milked.

Daily use of the lounge area. Movement within the lounge was estimated by determining the number of times that the cows entered the area and the length of time which they spent loitering and resting there (Table 2).

The type of roughage provided appeared to have a definite influence upon the amount of use which the cows made of the lounge. When both hay and silage were fed, each cow entered the lounge an average of 6.2 times daily and spent 12.4 hours there. With hay alone, the cows entered only 4.2 times daily but spent 15.9 hours loitering and resting in the lounge.

TABLE 2—Daily movements of cows in the lounge area when roughage was self-fed in the lot

	When self-fed roughage was					
	Hay and silage			Hay alone		
	6 a.m. to 6 p.m.	6 p.m. to 6 a.m.	Total daily	6 a.m. to 6 p.m.	6 p.m. to 6 a.m.	Total daily
Number of cows observed.....	60	60	...	57	57	...
Average times entered lounge..	3.2	3.0	6.2	2.3	1.9	4.2
Average minutes in lounge.....	327	420	747	364	574	938
Average minutes stayed per entrance.....	102	140	121	158	302	230
Average minutes loitering.....	149	113	262	179	121	300
Average minutes resting.....	178	307	485	185	453	638

These data reflect the observation reported previously that cows devote less time to loitering in the yard when they have access to hay as the only roughage.

The number of entrances into the lounge area were divided fairly evenly between day and night, although the cows spent more total time in the lounge during the night.

Of the 12.4 hours daily which the cows on the hay-silage ration spent in the lounge area, 65 percent was devoted to resting and 35 percent to loitering. On the all hay ration, the comparable figures were 68 and 32 percent respectively. Between 6 a. m. and 6 p. m. the lounge time was divided almost evenly between loitering and resting, but during the night 65 percent of the time was spent in resting when the cows received hay and silage and 79 percent when they had hay alone.

The considerable amount of traffic into the lounge area during both daylight and night hours is a major factor in the efficient use of bedding materials. In spite of the fact that cows are active during the night, these data support the recommendation of bedding the lounge area in the evening rather than in the morning. Passage in and out of the lounge is less during the hours of darkness, and the cows spend a larger proportion of their time lying down during these hours. When the lounge is bedded in the morning, the activity in the area and the relatively large amount of loitering causes the straw to become trampled and soiled before night. If the area is bedded in the morning, it should be bedded again late in the afternoon to keep the cows and area clean.

Undoubtedly, many of the reported cases of dirty barns and cows along with excessive straw consumption in loose-housing are due to improper management of the lounge area. Good management involves 1) arrangement of the lounge so that cows cross a minimum portion of the bedded area in order to lie down or to go into the paved lot: 2) outside feeding and watering to minimize the time which the cows spend in the lounge for purposes other than resting; and 3) bedding the lounge area after the evening milking to provide a clean bed during the hours of greatest lounge use.

SUMMARY

Observations on a herd of Brown Swiss cows in loose-housing were made in order to study their usage of the lounge area when hay and silage or hay alone was self-fed in the paved lot.

Traffic in and out of the lounge area was about evenly divided between day and night, although the cows spent more total time in the lounge during the hours of darkness. The time spent in the lounge during the daytime was about evenly divided between loitering and resting, while at night three-fourths of the time was spent in resting.

The cows spent more total time in the lounge when hay was fed. Hay appeared to be slightly more effective than hay and silage in inducing the cows to leave the lounge area immediately after milking, although a large percentage of the cows returned directly to the lounge, particularly after the morning milking, under both feeding conditions.

THE VALUE OF SNAPPED CORN-EAR SILAGE AND GRAINLESS CORN SILAGE (EARS REMOVED) FOR MILK PRODUCTION

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In previous studies, Huffman and Duncan (4, 5) have shown that when part of the hay in an all-hay ration was replaced with corn silage, on an equal total digestible nutrient (TDN) basis, milk production increased appreciably. The results indicated that corn silage contained the unidentified grain factor(s) needed for efficient milk production.

Dunn *et al.* (1) showed also that milk production was the same when normal corn silage was replaced with "recombined corn silage." The term "recombined corn silage" means that a proportionate amount of the corn and cob meal was added to the grainless corn silage at the time of feeding. Grainless corn silage was made from the stalks and leaves after the ears had been removed. The ears were then dried and ground to give corn and cob meal.

The purpose of this study was to determine the milk-producing value of snapped corn-ear silage and grainless corn silage.

EXPERIMENTAL

Alternate strips of green corn were cut and chopped into the silo in the early dent stage. About 5 percent of the stalks were without ears. The corn was cut in 0.5-inch lengths for silage. The ears on the remaining strips of green corn were either husked and dried for corn and cob meal or snapped and chopped into the silo for corn-ear silage. The pH of the grainless corn silage and the corn-ear silage was 3.96 and 4.23, respectively. Both silages were of excellent quality.

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The chemical composition, coefficients of digestibility, digestible protein, and the TDN content of the various feedstuffs are presented in Table 1. The coefficients of digestibility for red clover hay and grainless corn silage were determined by digestion trials, whereas the coefficients reported by Livesay *et al.* (6) were used for the corn-ear silage. Morrison's (7) coefficients were used for corn grain. The coefficients for corn and cob meal were calculated by using Morrison's coefficients for corn grain and corn cobs.

Six milking cows which had been depleted of their milk-producing factor(s) on clover hay alone were used in 6 trials with corn-ear silage, and 8 cows were used in 8 trials with grainless corn silage. The control periods in all of the trials consisted of the last 12 days on hay alone. All of the experimental periods were 18 days in length, except when 9 pounds of corn and cob meal replaced 25 pounds of corn-ear silage. The cows used in the trials with corn-ear silage averaged 150 days in lactation, whereas those used in the grainless corn silage trials averaged 225 days.

The cows were weighed every third day. The milk was weighed at each milking and 3-day composite samples were saved for butterfat tests. Milk production is expressed as 4 percent fat-corrected milk (FCM).

TABLE 1—Chemical composition, coefficients of digestibility, digestible protein, and TDN content of the experimental feeds

Feed	Moisture	Ash	Protein	Ether ext.	Crude fiber	NFE	Dig. pro.	TDN
	%	%	%	%	%	%	%	%
Red clover hay (some grass)	12.1	5.7	10.7	1.6	29.4	40.5	5.03	46.8
Coefficients	....	....	47	51	52	61	....	....
Corn silage (grainless)	69.6	2.3	2.9	1.0	8.3	15.9	1.23	17.9
Coefficients	....	....	42	59	63	64	....	....
Corn-ear silage	63.9	0.8	3.4	1.2	4.5	26.2	1.86	26.5
Coefficients	....	....	54*	34	80	80	....	....
Corn and cob meal	13.6	3.3	8.8	3.0	7.3	64.0	5.46	68.7
Coefficients	....	....	62†	70	57	85	....	....
Corn meal	11.3	2.0	8.5	3.3	2.8	72.1	6.58	81.8
Coefficients	....	....	77‡	57	90	93	....	....

*Coefficients reported by Livesay *et al.* (6).
†Coefficients were calculated from Morrison's (7) coefficients.
‡Morrison's coefficients (7).

TABLE 2—Chemical composition, digestible protein, and TDN of corn-ear silage, grainless corn silage, corn husks, and corn and cob meal, on the dry basis

	Corn-ear silage		Corn and cob meal	Corn husks	Grainless corn silage	
	Experimental	Morrison (7)	Experimental	Patterson (8)	Experimental	Livesay *et al.* (6)
	%	%	%	%	%	%
Protein	9.4	8.9	10.4	3.6	9.5	6.4
E. ext.	3.3	3.8	2.5	0.9	3.3	2.3
C. fiber	12.5	12.9	8.7	35.7	27.3	34.3
NFE	72.3	72.1	76.8	56.0	52.3	50.9
Dig. pro.	5.15	4.91	6.45	1.04	4.05	2.26
TDN	73.4	73.7	80.6	71.9	58.9	57.0

RESULTS AND DISCUSSION

The chemical composition, digestible protein, and the TDN content of the corn-ear silage, grainless corn silage, and corn and cob meal are presented in Table 2. Corresponding data for these feeds which have been reported in the literature (6, 7, 8) are included for comparative purposes. There is good agreement between our data and that reported by Morrison (7) for snapped corn-ear silage. The corn and cob meal, however, is lower in crude fiber and higher in nitrogen-free extract (NFE) and TDN than the corn-ear silage. The difference in composition was probably due to the inclusion of the husks in the snapped corn-ear silage. No data appears to be available on the chemical composition and digestibility of corn husk silage. The chemical composition, digestible protein, and TDN content of the corn husks reported by Patterson (8) are given in Table 2. The coefficients of digestibility of protein, ether extract, crude fiber, and NFE were also determined from digestion trials with two steers and found to be 29, 32, 79, and 75, respectively. The coefficient of digestibility obtained for the crude fiber in the corn-ear silage used in this work was 80 in comparison to 79 reported for the corn husks.

Milk production and changes in body weight from the trials with corn-ear silage and grainless corn silage are illustrated graphically in Figs. 1 and 2. Fig. 1 shows that FCM increased from approximately 16.0 to 20.8 pounds per day on 0.5 pounds less TDN when 25 pounds of corn-ear silage replaced 15 pounds of clover hay. All six

of the cows showed a marked increase in milk production against the natural tendency to decline with advancing lactation.

Furthermore, milk production was maintained at the higher level when 9 pounds of corn and cob meal replaced 25 pounds of corn-ear silage. Body weight declined for the first 12 days on corn-ear silage ration before leveling off, but the weights did not change appreciably when the corn and cob meal was fed. The drop in body weight of the cows on the corn-ear silage ration may have been due to less dry matter intake.

The milk-stimulating power of the corn-ear silage is attributed to the unidentified factor(s) present in young grass and grain. This factor(s) is needed to balance mature roughages and has been shown by Huffman *et al.* (2, 3) to be present in corn grain and by Huffman and Duncan (4, 5) to be present in corn silage. Recently, Dunn *et al.* (1) showed that the corn grain in corn silage was just as valuable for efficient milk production as corn meal. The results suggest that in seasons of early frost, snapped corn ears may be ensiled as a source of grain for milking cows. The data also indicate the need for grain to balance the roughage portion of the ration.

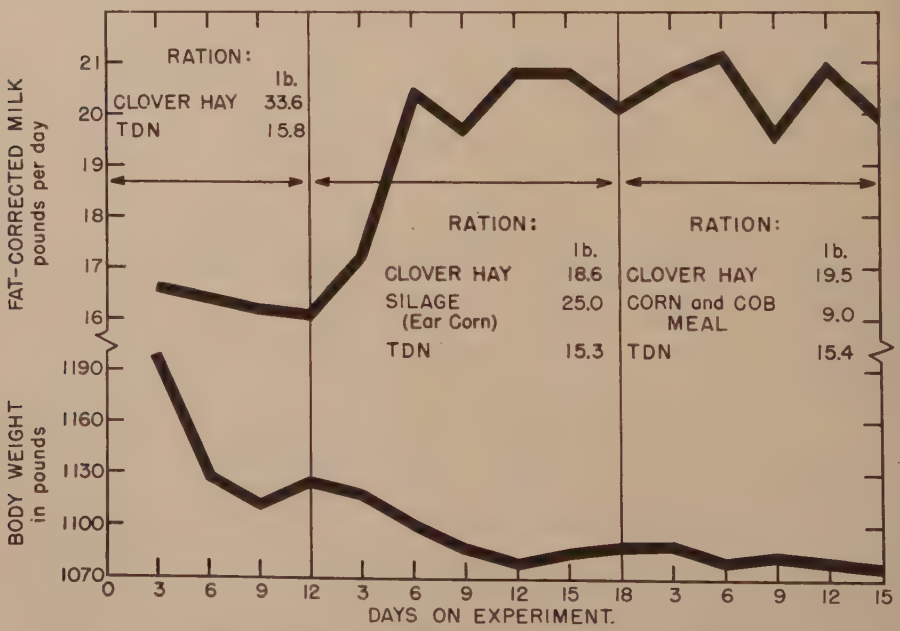

Fig. 1. The effect obtained on body weight and fat-corrected milk when part of the total digestible nutrients in an all-hay ration was replaced with corn-ear silage and then with corn and cob meal.

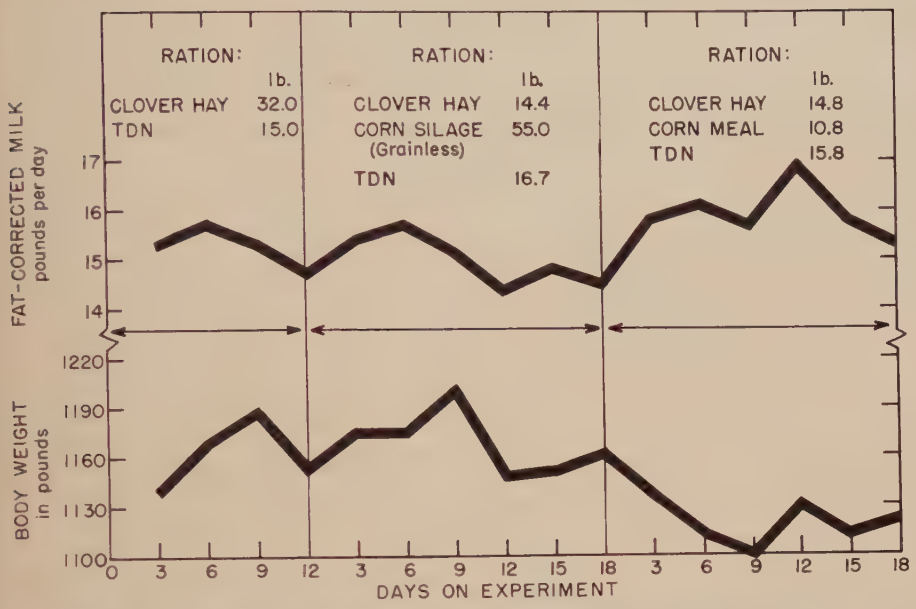

Fig. 2. The effect obtained on body weight and fat-corrected milk when part of the total digestible nutrients in an all-hay ration was replaced with grainless corn silage and then with corn meal.

Fig. 2 shows that a slight increase was obtained in FCM when 55 pounds of grainless corn silage replaced 17.6 pounds of clover hay. The initial increase, however, may have been due to an increased intake of 1.7 pounds of TDN per day during this period. This was brought about by the failure of the cows to consume all of the 35 pounds of hay during the basal period.

When the 55 pounds of grainless corn silage was replaced with 10.8 pounds of corn meal, FCM increased from 14.6 to a peak of 16.9 pounds per day. The decline in milk production during the last two 3-day periods on corn meal was due to the fact that several of the cows were at the end of their lactation and were about dry. The decline in body weight during this period was probably due to less dry matter intake.

The results obtained by Dunn *et al.* (1) showed that recombined corn silage (grainless corn silage plus corn and cob meal) was equal to corn silage for milk production. The results reported in this paper indicate that the corn stalks in corn silage were equal in feeding value to hay for milk production. The results obtained with grainless corn silage, however, should not be construed to mean that such silage is

either practical or economical. But the results do suggest the value of the corn stalks in corn silage in terms of hay equivalent and the corn grain as grain equivalent.

SUMMARY

Corn-ear silage was made by chopping corn ears into a silo. The stalks from which the ears had been removed were then harvested and chopped into a silo.

The data obtained from the corn-ear silage compared favorably in chemical composition and TDN content with that reported by Morrison (7). The TDN content of the corn-ear silage and the corn and cob meal was 73.4 and 80.6 per cent, respectively, on the dry basis. The difference was thought to be due to the presence of the husks in the snapped corn-ear silage.

When corn-ear silage replaced an equal amount of TDN in hay, FCM increased from 16.0 to 20.8 pounds per day, against the tendency for milk production to decline as lactation advances. The amount of FCM was maintained when 9 pounds of corn and cob meal replaced 25 pounds of corn-ear silage. When 55 pounds of grainless corn silage replaced 17.6 pounds of clover hay, the slight increase in FCM was not considered significant because the TDN intake was somewhat higher. The amount of FCM increased from 14.6 to 16.9 pounds per day when 10.8 pounds of corn meal replaced 55 pounds of grainless corn silage.

These results support previous findings which indicate that an unidentified factor(s) in corn grain is needed to balance hay.

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"CHEMICAL" BARK PEELING OF ASPEN 1952 AND 1953 FIELD TESTS

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Experiments to determine the effectiveness of a number of chemicals on loosening the bark in trembling aspen (*Populus tremuloides* Michx.) were started in 1951[1] and continued through the growing seasons of 1952[2] and 1953.

The results of the 1951 and 1952 field experiments indicated that the volume of chemicals used per tree may be as significant as the concentration used. It was decided, therefore, to give some attention in the 1953 field experiments to the effect of varying the volume of chemicals used per stem. An attempt was also made to evaluate the peeling characteristics of the bark with a "Swedish Bark Testing Tool".

1953 RE-EXAMINATION OF THE 1952 EXPERIMENTS

The plots for these experiments were established at the Dunbar Forest Experiment Station, Sault Ste. Marie, Mich. and on the properties controlled by the Patten Logging Company, Amasa, and William Bonifas Lumber Co., in Menominee County. Plots established on the American Box Board Company property, near Filer City, were partially cut before final data were secured, and therefore, were excluded from this report.

Lots of five to ten trees each were treated at various times by all cooperators from the middle of May 1952, through the middle of August.

The following chemicals, applied as a stem spray in diesel oil, were used: 2, 4-D ester (propylene glycol butyl ether ester of 2, 4-dich-

[1]Day, M. W., Hammer, C. L. and A. J. Panshin (1952). Preliminary observations on the effect of 2,4-D and 2,4,5-T on aspen. Michigan Agr. Exp. Station Quarterly Bulletin 34: 266-276.

[2]Panshin, A. J., Raphael, H. J. and M. W. Day (1953). Further observation on "Chemical" bark peeling of aspen. Mich. Agric. Exp. Station Quarterly Bulletin 35: 474-481.

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lorophenoxyacetic acid), 2, 4, 5-T ester (propylene glycol butyl ether ester of 2, 4, 5-trichlorophenoxyacetic acid), a mixture of 50 percent of 2, 4-D ester and 50 percent of 2, 4, 5-T ester (Brushkiller). In addition, a 25 percent water solution of sodium monochloroacetate was used. The esters were applied in 8 pounds a.h.g. (acid equivalent per 100 gallons of solution) concentration, at a rate of about 1 gallon of solution per 10 stems.

The results, based on examination of the plots in September of 1952 and in June of 1953, are recorded in Tables 1 and 2.

TABLE 1—Percent of trees dead, September 1952, and June 1953

	Dunbar		Bonifas		Patten	
	1952	1953	1952	1953	1952	1953
2,4-D ester, stem spray						
May	...	...	100	100	...	...
June	100	100	100	100	32	79
July	44	54	50	100	33	80
August	10	50	11	78	...	...
September	...	...	0	10	...	...
2,4-D ester 50% and 2,4,5-T ester 50%, stem spray						
May	...	...	100	100	...	...
June	...	...	100	100	85	90
July	...	...	70	100	90	100
August	...	...	10	60	30	60
2,4,5-T esters, stem spray						
June SS*	95	100	...	...	...	...
June DS*	100	100	...	...	...	...
July SS*	79	90	...	...	...	...
July DS*	83	93	...	...	...	...
July TS*	100	100	...	...	...	...
August SS*	0	50	...	...	...	...

*SS—single strength; DS—double strength; TS—triple strength.

TABLE 2—Percent of trees dead, September, 1952 and June, 1953

Sodium monochloroacetate

	Girdled				Girdled and Scored				Frilled	
	Dunbar		Patten		Bonifas		Patten		Dunbar	
	1952	1953	1952	1953	1952	1953	1952	1953	1952	1953
May	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
June	20	33	0	55	.....	.....	0	80	100	100
July	64	83	0	60	.....	.....	0	100	80	90
August	.....	.....	.....	.....	0	70	.....	.....	100	100
September	.....	.....	.....	.....	0	80	.....	.....	.....	.....

BARK CONDITION

Observations made at Dunbar Experiment Station in the fall of 1952 indicated that the bark was loose enough for satisfactory peeling in a drum barker on all trees killed with the sodium monochloroacetate and 2, 4, 5-T ester. Bark on the trees treated with 2, 4-D ester and the mixture of 2, 4-D and 2, 4, 5-T showed green areas which clung tightly to the stem.

The 1953 re-examination of the same trees showed that, regardless of the chemical used, bark on all dead trees was loose enough for satisfactory woods peeling. Condition of the bark on the injured trees varied considerably, but it was felt that such trees would peel satisfactorily in the drum barker. These conclusions were largely confirmed by the check made on the Patten properties.

Greying of sapwood had increased considerably from the fall of 1952 to June of 1953, particularly in the sodium monochloroacetate treated trees. Insofar as this type of discoloration increases bleaching costs, fall peeling should be desirable whenever brightness of pulp is of primary consideration. The 1952 fall observations indicate that only trees killed with 2, 4, 5-T and sodium monochloroacetate were in a peelable condition. Therefore, the effectiveness of each chemical as a bark peeling aid can be measured by the percent of trees killed by the end of the growing season during which treatments were made.

The general conclusions reached from re-examination of the plots were that treatments made in August were less reliable than those made earlier. Sodium monochloroacetate was most effective when

applied to frills. Both 2,4,5-T ester and the mixture of 2,4-D and 2,4,5-T were about equally effective, whereas 2,4-D ester alone gave inconsistent results.

1953 EXPERIMENTS

At Dunbar

The purpose of the 1953 experiment was (1) to determine the effect of varying the volume of chemicals used per tree, and (2) to measure the results of treatment, in terms of the degree of bark loosening, with a Swedish Bark Testing Tool. To minimize the effect of diameter variations, only trees measuring 6 to 8 inches DBH were selected.

The chemicals used, the concentration, the volume applied per tree and the method of treatment are shown in Table 3. The results were checked on September 8, 1953, and again in June of 1954. The trees were grouped as dead, injured, and healthy. At the same time, the extent of discoloration in the wood and the condition of the bark were determined. This information is also presented in Table 3.

Swedish Bark Testing Tool

This device has been extensively used at the State University of New York, College of Forestry, for measuring bark peeling characteristics of treated and untreated pulpwood species.[3] The tool consists of a barrel saw two inches in diameter with which a two-inch circle is rimmed through the bark. Care is taken not to cut into the wood. A pronged bar is fitted into this circle and a spring scale attached to its free end. A steady pull is exerted on the scale until the circle of bark is detached. Maximum pressure required to detach the bark, measured in grams, is read off the scale.

In order to establish a basis for comparison, similar information was obtained on untreated trees on the same days when determinations were made on treated aspen. Final readings on treated trees were obtained with the tool on September 8. On the same date, supplementary information on ease of peeling was also obtained by inserting a sharp tool under the bark and by pulling it off by hand. The trees on which the bark separated easily and for some distance were classed as "peeling"; the others were rated as "non-peeling."

[3]Wilcox, Hugh, Czabator, Felix, and Guido Girolami (1954). Seasonal variations in bark-peeling characteristics of some Adirondack pulpwood species. Jour. Forestry 52: 338-342.

The results obtained with the tool and by hand peeling are presented in Table 4. Considerable variations in the gauge readings obtained with the Swedish tool were registered, throwing doubt on the reliability of the instrument as a means for measuring accurately the force required to separate the bark. It was also found that considerable variation in readings taken in adjacent areas on the same stem were obtained.

The wide variations in the results obtained are traceable largely to the instrument itself. Its successful operation depends on the cut being made completely through the bark, but in such a way that no wood is severed. Furthermore, the prongs of this tool must be inserted to exactly the right depth, i. e., they must penetrate through the entire thickness of the bark, but must not be lodged into the wood. Both of these conditions are extremely difficult to meet in practice, at least on a thin-barked tree such as aspen. Considerable difficulty was also experienced in observing the maximum readings of the scale at the precise moment when the disk of the bark separates. At the higher readings, particularly on the untreated aspen, the prongs had a tendency either to pull out or to rupture the bark disk.

In the case of aspen, the use of the Swedish Bark Testing Tool presents too many practical difficulties for evaluating the effectiveness of treatment in terms of ease of bark peeling. A knife test is more reliable from the standpoint of supplying practical information on the degree and extent of bark loosening.

RESULTS OF 1953 EXPERIMENT

Sodium monochloroacetate was applied in 25 and 50 percent concentrations to frills, in quantities ranging from 8 to 30 trees per quart of solution. As expected, the 50 percent concentration and the larger quantities of solution per stem resulted in a larger percentage of trees killed (Table 3).

The manner of bark slipping was found to be markedly different from that obtained in 1952. In that year, both the outer and the inner bark peeled freely on all the dead and dying trees 30 days after the application of the chemical. In the 1953 series, however, the outer bark could be stripped off on most of the trees classed as dead or injured, but the inner bark remained firmly attached to the tree. This condition prevailed regardless of the concentration of the chemical used.

TABLE 3—Condition of trees treated during June and July 1953 as reported September 1953 and June 1954

Concentration pounds	Gallons per 10 trees	Total trees*		Degree of injury						Discoloration				Peelability			
				D†		I		H		N		DS		P		S	
		'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54	'53	'54
JUNE TREATMENTS																	
Brushkiller—Basal Spray																	
8‡	2	10	10	6	9	3	1	1	..	9	9	1	1	8	5	2	5
8	1	10	10	1	1	1	3	8	6	10	10	..	..	3	10	7	..
8	½	10	10	4	4	1	2	5	4	9	9	1	1	5	8	5	2
8	⅓	10	10	..	..	..	8	10	2	10	10	..	..	1	7	9	3
Brushkiller—Frill																	
8	¼	9	4	3	3	4	1	2	..	5	4	5	..	6	2	3	2
Diesel Oil—Frill																	
	¼	10	9	..	6	..	2	10	1	10	9	..	..	..	8	10	1
Frill—No Chemical																	
		10	9	1	2	1	5	8	2	10	9	..	..	..	6	10	3
Sodium Monochloroacetate—Frill																	
2	⅓	8	5	4	3	2	2	2	..	..	..	8	5	7	3	1	2
Ammate—Frill																	
2	½	9	8	5	8	4	..	..	..	7	1	2	7	..	4	9	5
2	¼	10	9	8	9	2	..	..	..	10	6	..	3	1	7	9	3
4	½	10	10	10	10	..	..	..	..	6	1	4	9	5	7	5	3
4	¼	17	14	16	14	1	..	..	..	12	3	5	11	5	9	12	5
7	½	10	7	10	7	..	..	..	..	6	4	4	3	8	6	2	1
7	¼	10	9	10	9	..	..	..	..	6	1	4	8	8	7	2	2
JULY TREATMENTS																	
Sodium Monochloroacetate—Frill																	
2	¼	10	9	9	9	1	..	..	..	1	1	9	8	..	9	10	..
2	⅛	10	10	5	6	5	4	..	..	..	..	10	10	9	7	1	3
2	1/12	10	10	2	6	8	4	..	..	2	2	8	8	1	8	9	2
4	¼	10	9	10	9	..	..	..	..	..	..	10	9	4	8	6	1
4	⅛	10	5	6	4	4	1	..	..	..	..	10	5	3	5	7	..
4	1/12	10	8	9	8	1	..	..	..	..	..	10	8	1	8	9	..
2 parts Sodium Monochloroacetate—1 part Ammate																	
6	¼	5	5	4	5	1	..	..	..	..	..	5	5	4	4	1	1
6	⅛	5	5	2	2	3	3	..	..	..	..	5	5	1	3	4	2
6	1/12	5	5	..	1	4	3	1	1	2	2	5	3	..	2	5	3

*Due to windfall and breakage during the year, the total number of trees shown for 1954 is less in some instances than the 1953 number.

†D—dead. I—injured. H—healthy. N—not discolored. DS—discolored. P—bark peels. S—bark sticks.

‡All brushkiller applied 8 lb. a.h.g. (acid equivalent per 100 gals. solution).

All other numbers refer to pounds per gallon of water.

These trees were re-examined in November, at which time it was found that all dead trees peeled a little more easily than in September. The bark on the other treated trees was as tight as that on the untreated aspen. Further check in June of 1954 revealed that the bark on most dead trees was split from frill to crown and was readily sloughing off. The inner bark showed no evidence of sticking. Deep sapwood discoloration (up to 2″ on some trees) was present on all trees.

Every tree was examined for discoloration of the sapwood. This was recorded as *none, slight,* and *pronounced.* Most of the dead and injured trees exhibited some discoloration, ranging from slight to pronounced. Discoloration in this series was more pronounced than in trees treated with the other two chemicals. This fact in itself may be enough to preclude use of sodium monochloroacetate on a commercial scale.

A mixture of 50 percent 2,4-D and 50 percent 2,4,5-T esters was applied as a stem spray in 8 pound a.h.g. concentration, at the rate of one gallon of solution per 5 to 30 trees. The 30 trees per gallon application had no apparent effect on aspen. All trees treated in this series were healthy in September and all showed high bark gauge readings.

TABLE 4—Comparison of bark gauge readings (grams) and hand peeling characteristics of trees, selected at random, from each group of treatments. (Trees treated June 1953; tested Sept. 8, 1953)

Treatment	Concentration (lbs.)	Gallons per 10 trees	First tree		Second tree		Third tree		Average§ gauge reading
			Gauge	Hand	Gauge	Hand	Gauge	Hand	
KS*.....	8†	2	2600	P‡	4800	P	1200	P	2867
KS.....	8	½	3800	S‡	4500	S	2700	P	3666
KS.....	8	⅛	4200	S	4300	S	5400	S	4733
F*.....	—	—	4800	S	4300	S	4400	S	4500
DF*.....	—	¼	3300	S	4500	S	3900	S	3900
KF*.....	8	¼	5000	P	6000	S	4900	P	5300
M*.....	2	⅛	400	P	3800	S	—	—	2100
A*.....	4	¼	4500	S	3800	P	3300	S	3867
KS.....	8	1	3700	S	4800	S	2200	P	3567
A.....	2	½	2600	S	3500	S	4500	S	3533
A.....	2	¼	2700	S	4800	P	2800	S	3433
A.....	4	½	2400	P	4000	S	1000	S	2467
A.....	4	¼	2700	P	3500	P	1000	S	2400
A.....	7	½	3200	P	2000	P	3300	S	3033
A.....	7	¼	2900	P	2500	S	2300	P	2567

*KS—Brushkiller (basal spray). F—Frill (no chemical). DF—Diesel oil (frill).
KF—Brushkiller (frill). M—Sodium monochloroacetate (frill). A—Ammate (frill).
Average of 5 untreated trees, tested Sept. 9, 1953—5280 lbs.
†All Brushkiller applied 8 lb. a.h.g. (acid equivalent per 100 gals. solution).
All other numbers refer to lbs. per gallon of water.
‡P—peels. S—sticks.
§Average of 15 untreated trees, tested June 15, 1953—1197 lbs.

Only two trees could be peeled with the knife. Somewhat better results, in terms of number of trees killed, were obtained with higher volume of spray. All dead trees showed satisfactory peeling characteristics in September, and little or no sapwood discoloration was observed (Table 4). Reexamination in June, 1954, showed no bark splitting. However, the bark peeled off fairly easily, except in the upper part of the trunk, where it clung tightly. Discoloration of sapwood was found only on two trees.

Ammate was applied to frills in concentrations of 2, 4 and 7 pounds of salt per gallon of water. Each of these concentrations was applied at the rate of one quart of solution per 5 and per 10 trees. The two higher concentrations produced practically 100 percent kill. Varying the volume had little effect on the effectiveness of the chemical.

Bark peeling tests gave spotty results. Some of the dead trees, particularly those treated with the 7 pound solution, peeled satisfactorily. In each group, however, there were some dead trees on which the bark was tightened to the extent that they were classified as "non-peeling." The November check revealed that the bark on some of the dead trees peeled somewhat more easily than it did in September, apparently because it had more time to disintegrate. The sapwood was not discolored, or only slightly so. In June 1954, the bark peeled off fairly well, except in the upper parts of the trunk. Considerable sapwood discoloration was observed on most trees.

COOPERATORS:[4]

In order to check the effectiveness of the sodium monochloroacetate and a mixture of 50 percent 2,4-D and 50 percent 2,4,5-T esters when applied on a scale approximating commercial operations, plots were established in Menominee County, on the William Bonifas Lumber Company properties, and at Amasa, on the Patten Logging Company tract.

Wm. Bonifas Lumber Company—A 25 percent solution of the sodium monochloroacetate was applied at the rate of one gallon per 50 trees in girdles. A total of 180 stems were treated on May 12, and 200 on July 15. A check of the plots was made in September, at which time it was estimated that approximately 40 percent of the trees treated in May and 60 percent of the trees treated in July were dead.

[4]The authors wish to express their appreciation to the following individuals, and the companies they represent, for performing this work and for collecting the data at their own expense; M. L. Strengberg, Patten Logging Co. and L. M. Argetsinger, William Bonifas Lumber Co. Some of the chemicals used in these experiments were furnished by the Dow Chemical Company.

The sapwood was stained appreciably on the trees treated in May; it was mostly bright on those treated in July. Considerable variation in peelability was encountered in the dead trees, but most of these could have been peeled in a drum barker. Re-examination made at a later date in the fall indicated considerable tightening of the bark.

A mixture of 50 percent 2, 4-D and 50 percent 2, 4, 5-T was prepared by mixing 2.56 fluid ounces of chemical per gallon of kerosene (8 pounds a.h.g.). It was applied as a basal spray to the lower 18 inches of the stem at the rate of 1 gallon per 30 or 40 trees.

Five different applications were made between May 13 and September 2 at about 2 week intervals. A total of 585 trees were treated. An additional 100 trees were treated with double strength in September.

About 50 percent of the trees treated in May and June had brown tops on September 16, and were presumed to be dead. Only 10 percent of the aspen treated in July and later were dead at the time of examination in September. Considerable variation in bark condition was observed, but the dead trees could have been peeled in a drum barker. The wood on most trees was bright.

The application of ammate, containing 6 pounds of salt per gallon of water, was made on May 15 to 100 trees, and on July 14 to 600 trees. The chemical was applied at the rate of 1 gallon per 50 trees to sapwood girdles and frills. It was observed that by September 16 the treated aspen had lost about 90 percent of its leaves; the remaining leaves stayed green. Little sapwood discoloration was observed.

The bark peeled fairly well on all the dead trees until about September 1, after which date it tightened appreciably. This lot of aspen was cut on January 19, and a truckload of pulpwood was drum barked on January 25. This lot proved to be as difficult to bark as untreated control trees cut on the same date. The color of the bark was largely green, and the wood bright in color. It was concluded, therefore, that ammate is not satisfactory for facilitating bark peeling of aspen.

Re-examination in June, 1954 revealed that even small trees treated with sodium monochloroacetate and Brushkiller were harder to peel than untreated trees. The inner bark on many trees was sticking, and sapwood discoloration was prevalent.

Patten Logging Company—One application of sodium monochloroacetate in a 25 percent concentration, was made to 654 trees in June. The chemical was applied at the rate of one gallon per 25 trees. No

actual count of dead trees was made, but it was estimated that most of them had green leaves in September. On trees with the entire crown dead, the outer bark came off easily but in small patches; the inner bark clung tightly to the stem.

A mixture of 50 percent 2,4-D and 50 percent 2,4,5-T, made in 8 pounds a.h.f. concentration, was applied to 769 trees, as a basal spray at the rate of 17 trees per gallon. In September, the crowns were completely dead on most treated trees. The bark, however, remained green and was tight on the majority of trees. Re-examination of the treated trees in June 1954 revealed conditions similar to those reported for the Bonifas Lumber Company.

SUMMARY

Field experiments on the effectiveness of sodium monochloroacetate, ammonium sulfamate, and a mixture of 50 percent 2, 4-D and 50 percent 2, 4, 5-T esters on loosening of bark in trembling aspen. (*Populus tremuloides* Michx.) were continued through the 1953 growing season. The chemicals were applied in different concentrations and volumes per stem.

The use of higher concentrations and larger amounts of chemicals resulted in a higher percentage of treated aspen killed. Neither sodium monochloroacetate nor the mixture of 2, 4-D and 2, 4, 5-T esters were found to be sufficiently consistent in killing aspen, except when they were used in concentrations and amounts which would not be considered economical when applied on a commercial scale. Satisfactory kill was obtained with 4 and 7 pound solutions of ammonium sulfamate, applied at the rate of one quart per 5 to 10 trees.

Satisfactory bark peeling could be had with all of these chemicals if a complete kill is obtained. When the cambium of trees is only partially killed, peeling is effective only on the portions of the stem killed. The bark between these areas remains tight. The bark tends to tighten again in the late fall on trees killed with ammate, and to some exent on those killed with sodium monochloroacetate.

The bark on trees killed with 2,4-D and 2,4,5-T comes off in large pieces, while that on trees treated with sodium monochloroacetate is of a crumbly nature, and is not in good condition for woods peeling.

Excessive discoloration of sapwood was encountered in the sodium monochloroacetate treated aspen. The extent of discoloration caused by the other two chemicals was less significant.

Compared to the 1952 experiments, the results were much less satisfactory, both in the percent of trees killed and the condition of the bark. Excessive dryness prevailing in August may have been partially responsible for these results. Three years of field trials have proved that there is a lack of uniformity in the lethal effect of the chemicals used and too much variation in the bark peeling characteristics of treated aspen. Therefore, the use of these chemicals on a commercial scale cannot be recommended.

ANATOMICAL CHANGES IN TREMBLING ASPEN (*Populus tremuloides Michx.*) INDUCED BY THE APPLICATION OF CHEMICAL AGENTS TO THE STEM

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This article describes the anatomical changes which take place in trembling aspen as a result of the chemical treatments described in the article 37-25. The experimental procedure and field observations for this study are described in Michigan State College Quarterly Bulletin Articles 35-59, May 1953; and 37-25 November 1954. Reprints of these articles are available by writing to Michigan State College, Department of Information Services, Bulletin Office, East Lansing, Michigan.

In the manufacture of pulp and paper, it is imperative that all bark be removed from the pulpwood stick before it is processed. Particles of bark are objectionable because they are not reduced to pulp and show up in the finished paper as specks. When chemical pulping methods are used, bark consumes chemicals and steam and occupies digester space that could be used by additional wood chips.

The best time to remove bark from trees is during the so-called sap-peeling season. For aspen in the Lake States, this season extends from about the beginning of May until the end of August, depending on the location within the region. During this season, the cambial region consists of a wide belt of relatively thin-walled cells. These walls can be ruptured easily, and the bark can be stripped from the tree.

Before and after the sap-peeling season, the cambial region is narrow and the cell walls relatively thick. During these periods, it is virtually impossible to remove bark by hand and very difficult to remove it by mechanical means. Pulpwood sticks frequently must be sent through typical drum barkers three or four times in order to

ARTICLE 37-26

remove all the bark. If cut and barked during the sap-peeling season, most sticks will bark cleanly with one, or at most two trips through the barker.

In the past, most mills have been able to cut and peel enough pulpwood during the sap-peeling season to satisfy their annual requirements. However, in recent years there has been a distinct scarcity of woods labor, and mills have been forced to cut pulpwood before and after the sap-peeling season in order to meet their annual needs. This wood, of course, has been very difficult to peel and costs of bark removal have been increased considerably. As a result, numerous experiments have been conducted with chemicals in an attempt to kill standing trees during the growing season and then to maintain the bark in a peelable condition after the normal sap-peeling season closes.

It was felt that an understanding of how these chemicals caused bark loosening would be an aid to any future research on chemical barking of trees. Accordingly, the main purpose of this study was to observe the anatomical changes occurring in the cambial region of the stems of trembling aspen (*Populus tremuloides* Michx.), after the application of various chemicals to the trees. The major emphasis was placed on the stem because normally it is the only portion of the tree used in the manufacture of pulp and paper. Examinations were also made on the mid-rib portion of leaves, and on the cambial region of twigs and roots. Detailed field observations were also made in an effort to assemble additional data on the effects of chemicals on the trees.

The problem was limited to trembling aspen because of the recent increased use of this species as a source of pulpwood. Once considered a weed species, aspen has become the most important source of pulpwood in the Lake States on a volume basis. In 1953, approximately 939,000 cords (rough wood basis) were cut. This represented about 45 percent of the total pulpwood harvest in the Lake States. (4)

Description of the Cambial Region and Adjacent Tissues of the Stem of Untreated Aspen

This description is based on samples taken from stems at approximately 5 feet above the ground, and collected at various times during the growing season.

Cambial region: The cambial region, including undifferentiated xylem and phloem cells, varies from 5 to 15 cells in width, depending

on the time of season. The amount and nature of the cell contents also varies during the growing season, ranging from abundant to scarce, and from a granular to a semi-fluid state.

Xylem: The xylem of aspen stems is composed of vessels, fibers, longitudinal parenchyma, and ray parenchyma. The wood is typically diffuse porous, with vessels of approximately the same diameter throughout the growth rings. Vessels are in multiples of two or more, equipped with simple perforation plates. Longitudinal parenchyma is mostly terminal, forming a broken line at the extremity of each growth ring. Rays are uniseriate and follow a rather straight course through the xylem. Fibers are relatively numerous, especially in the outer portion of the rings; walls are relatively thin.

Phloem: The phloem consists of longitudinal parenchyma, ray parenchyma, sieve tubes, companion cells, fibers, and some sclereids. As seen in Fig. 1, sieve tubes are much larger and have thicker walls than the surrounding cells. Sieve plates, principally on the radial walls, are plainly visible because of their thick appearance due to

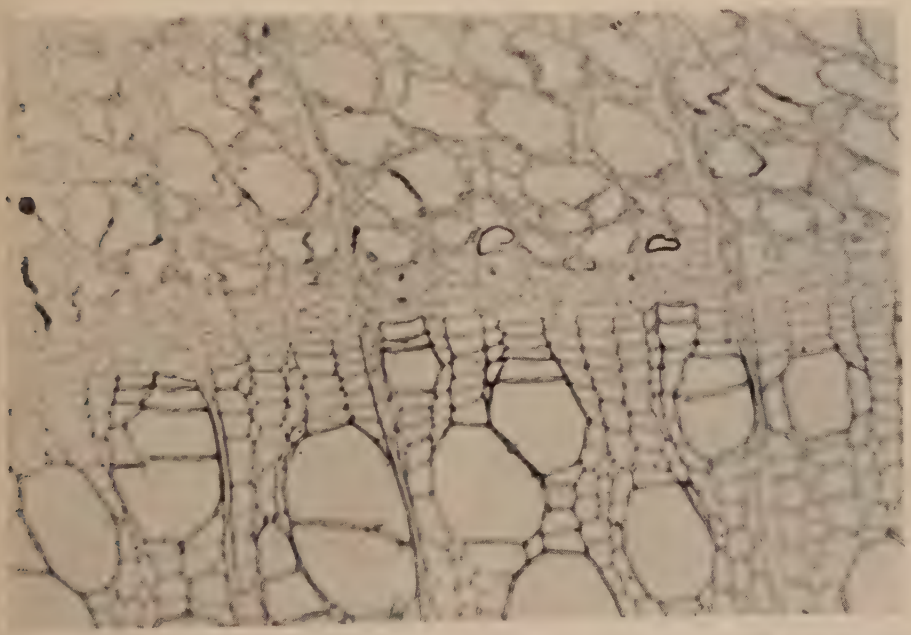

Fig. 1. Transverse section of the cambial region of an untreated aspen stem, showing prominent sieve tubes and sieve plates with callose. One extruded nucleolus can be seen at the extreme left of the section. (205X.) Sample was collected on July 30.

depositions of callose. Extruded nucleoli are a constant feature of the sieve tubes during the growing season; one can be seen at the extreme left of Fig. 1. Longitudinal parenchyma cells are smaller in diameter and have thinner walls than the sieve tubes; companion cells are the smallest in diameter, appearing to occupy the corners of the sieve tubes. Sieve tubes, companion cells, and longitudinal parenchyma cells form broad tangential bands of tissue which alternate with narrower tangential bands of fibers. Crystalliferous cells are frequently found in the vicinity of the fibers. Sclereids are occasionally found adjacent to the cambial region; farther out they are quite numerous and are interspersed among the fibers.

Progressive effects of chemical treatments on the cambial region and adjacent tissues of the stem.

Effects of sodium monochloroacetate (see Fig. 2). Cells of the cambial region were distorted and partially collapsed 15 days after

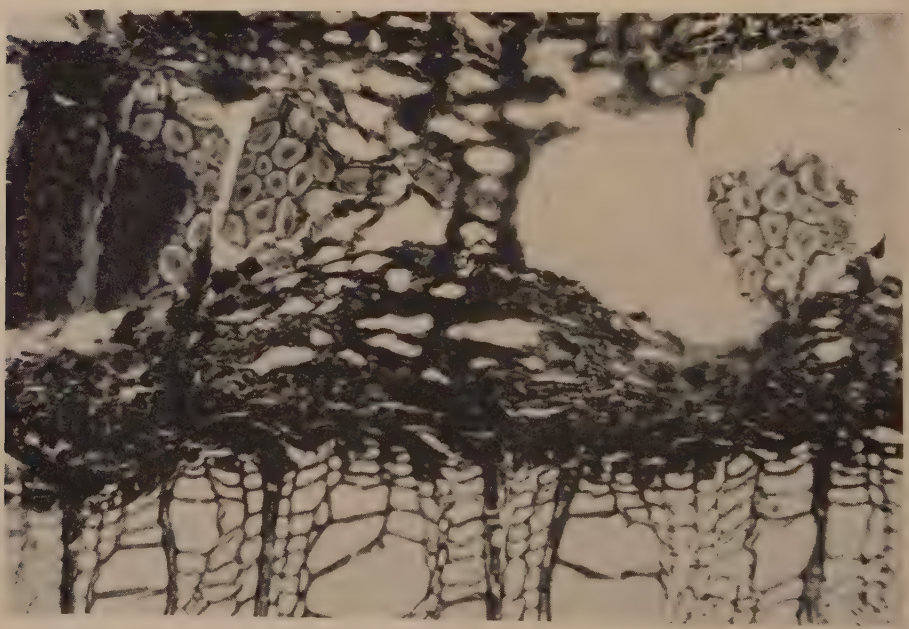

Fig. 2. Transverse section of the cambial region of an aspen stem treated with sodium monochloroacetate. Note blackened and distorted tissues of the cambium and phloem. (205X.) Tree was treated on June 24 and sample collected 71 days after treatment.

treatment. Cell contents became dark and, as more time elapsed, cell collapse became general and very severe throughout the region. This was followed by disintegration of cell walls and contents. Eventually the entire cambial region was transformed into tangential bands of blackened, structureless cell walls and cell contents.

The mature vessels and fibers of the xylem were not affected by the treatments. On the other hand, the walls of the newly-formed xylem elements showed signs of collapse 15 days after treatment. This condition became more pronounced until collapse was general in this part of the xylem, followed by cell wall disintegration. The result was the appearance of numerous lacunae between xylem and cambial region. Ray and longitudinal parenchyma cells frequently exhibited blackened walls and contents, although these cells collapsed only immediately adjacent to the cambial region.

The phloem was severely attacked, even as early as 15 days after treatment. The walls of most parenchymatous cells became blackened and increased in thickness; cells were twisted and distorted, and in a state of partial collapse. Later on collapse became very severe, especially in the sieve tubes; then a gradual disintegration took place. This disintegration became progressively greater and after 71 days, large voids were formed between bands consisting of intact fibers and sclereids, and remaining parenchymatous cells.

Sieve plates were very difficult to detect in the treated sections. This apparently was due to thickening of the walls containing the plates and a lining of dark cytoplasm which masked the plates. The plates were also devoid of callose in many instances, making their detection more difficult. Extruded nucleoli were very rare, in many cases none could be found in the entire phloem. Ray and longitudinal parenchyma cells of the phloem became blackened and distorted as a result of treatment. In many cases, rays disintegrated in the vicinity of the cambial region and assumed a twisted appearance throughout the rest of the phloem.

Effects of 2,4,5-T ester: The effects of 2,4,5-T ester were quite similar to those of sodium monochloroacetate but much less severe. The chemical did not injure the cells as fast as the sodium monochloroacetate, and when samples of the two treatments were collected on the same day and a comparison made, the 2,4,5-T sample was always affected less.

Fifteen days after treatment, only a few parenchymatous cells of the phloem were damaged. These had thickened walls and dark cell contents, but no collapse could be detected. Eventually the cambial region did collapse, but 71 days after treatment very little collapse had occurred in either the xylem or phloem as compared to the sample from the tree treated with sodium monochloroacetate. The effects of the two chemicals can be seen by comparing Fig. 2 and 3.

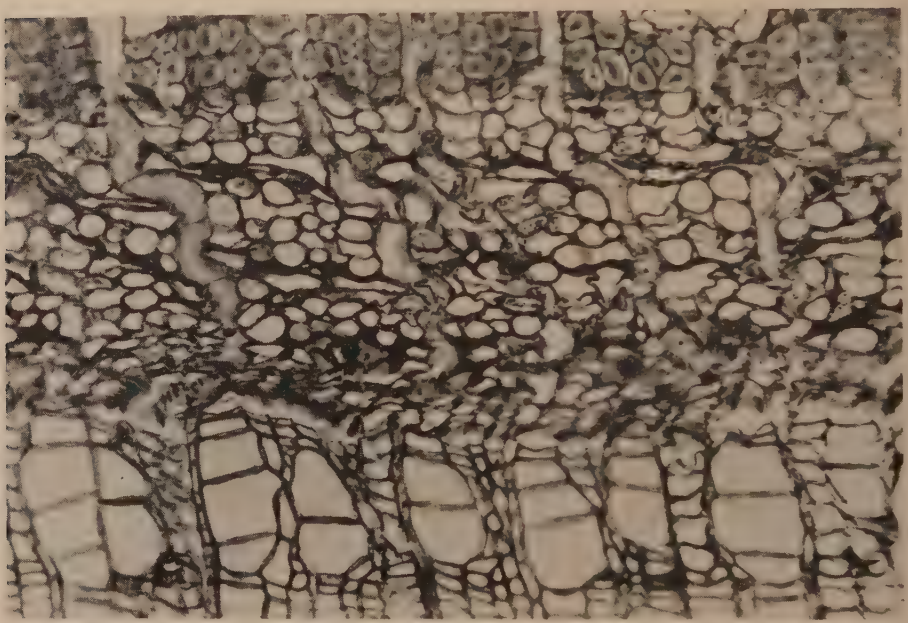

Fig. 3. Transverse section of the cambial region of an aspen stem treated with 2,4,5-T ester, showing advanced disintegration of cambium and thickened walls of parenchymatous cells in the phloem. (205X.) Tree was treated on June 24 and sample collected 71 days after treatment.

Effects of 2,4-D ester: The degree of injury was less in 2,4-D samples than in those of 2,4,5-T collected at the same time. Injury to most cells started at a later date, and never was as severe as that caused by 2,4,5-T.

Comments: The blackening of cell contents and walls, as described for these three treatments, is thought by some investigators to be caused by a release of tannin and phlobaphene compounds by dying ray and longitudinal parenchyma cells (3). Dark-stained sieve tube contents have been interpreted as the results of disorganization of the cytoplasm (5).

The absence of callose on sieve plates and the disappearance of extruded nucleoli in sieve tubes is associated with decreased activity of the phloem (1, 2). This was probably the case with the treated trees. The phloem was apparently in a state of decreased activity as a result of approaching death; this accounts for the absence of extruded nucleoli and of callose material.

CONCLUSIONS

Bark loosening due to chemical action: The results of this study suggest that bark loosening is caused by a combination of chemical and physical changes occurring in the cambial region and adjacent tissues of the tree stem. The collapse of newly-formed xylem cells and the accompanying lacunae, in conjunction with collapse and disintegration of cambial and phloem cells, results in the formation of a belt of weakened material. This material consists of remnants of cell walls and cell contents which can be ruptured very easily. Collapse of cells seems to be partially caused by a contraction of the entire phloem region. This contraction is evidently restrained by the xylem, causing long vertical splits to occur in the bark after treating.

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THE RECOVERY OF TRICHOMONAS FETUS AFTER FREEZING TO —79°C. IN PREPARED MILK SEMEN EXTENDER

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A NUMBER of workers, Fitzgerald, et al. (1954), Kendrick (1953), Bartlett, et al. (1947), and Vandeplassche (1953), reported a very low incidence of *Trichomonas fetus* infection in cows through the use of diluted semen from infected bulls.

More recently Leidl and Mahrla (1954) reported the recovery of *T. fetus* after freezing to –79° C. The cultures were frozen in a horse serum-beef bouillon-nutrient broth containing 1,000 gamma streptomycin per ml. and 10 percent glycerine. Upon thawing, the culture medium was incubated and viable trichomonads recovered after 24-72 hours.

Levine and Marquardt (1954), using CPLM with 5-10 percent glycerine added, froze cultures of *T. fetus* at the rate of 1° C. per minute to –76° C. in flame sealed 8 mm. glass ampules. An 80 percent recovery of viable trichomonads was reported.

The possibility of spread of trichomoniasis in artificial insemination, therefore, remains a constant threat.

The authors decided to determine the possible trichomonicidal effect of deep-freezing of *T. fetus* under conditions identical to those employed in the freezing and preservation of semen at –79° C. In order to carry out this investigation, it was first necessary to establish that *T. fetus* could survive and subsequently reproduce in the milk extender used for semen by the Michigan Artificial Breeders Coop.

METHODS AND MATERIALS

To determine the survival of *T. fetus* in prepared milk semen extender, trichomonads were recovered from three field sources and

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cultured in CPLM (Trussell, 1947) medium at 37° C. for 48 hours. Forty-four milk samples were inoculated with varying numbers of organisms ranging from 13 per ml. to 630,000 per ml. The pH range of the milk was 6.3 to 6.7. Twenty-four samples contained approximately 500 units per ml. each of dihydrostreptomycin sulfate and crystalline potassium penicillin. Twenty samples contained no antibiotics. These samples were incubated at 37° C. for a maximum of six days during which time daily examinations were made for motility. Where possible (29 samples), cell counts were made daily.

All samples on which cell counts were made showed a substantial daily increase which indicated positive reproduction. In only four samples was there no growth. All others showed motility and an apparent increase in numbers during incubation.

Having determined that *T. fetus* survived and reproduced in semen milk extender, the next step was to investigate the possible trichomonicidal effect of deep freezing of the organisms after a modified method of Polge and Lovelock (1952). This procedure consisted of the addition of plain or glycerinated homogenized milk to the culture medium and freezing either immediately or after an equilibration period of from 1 to 18 hours.

The homogenized milk was heated to 92° C. for a period of 10 minutes in a water bath. Where glycerinated milk was used, glycerine was added to give a final concentration of 7 percent vol./vol. of whole milk.

Freezing was accomplished by reducing the temperature in an alcohol-dry ice medium at the rate of 1° C. per minute from +5° C. to −15° C. At this point, the rate of freezing was increased to 3° to 5° C. per minute until −79° C. was reached.

The *T. fetus* milk suspensions were frozen in 1 ml. amounts in 2 ml. glass ampules or 2 ml. plastic vials.

The frozen samples were stored in a specially constructed dry ice cabinet with storage drawers fitted so they were accessible from a front door. The ampules or vials were continuously immersed in ethyl alcohol and the temperature maintained between −73° C. to −79° C.

Thawing was accomplished by immersing directly into water held at 5° C. or, more slowly, by placing in a refrigerator at 5° C. for one hour then allowing to warm further at room temperature.

The trichomonads used in this experiment were obtained from four different field case bulls and maintained in CPLM medium in the laboratory. These cultures will hereafter be designated as TFR, TFP,

TFM and TFB III. The CPLM medium contained 3.3 mg. dihydrostreptomycin sulfate per ml., 1250 units of crystalline potassium penicillin per ml. and 0.1 ml. sterile bovine serum per ml.

The cultures used had been incubated at 37° C. for 24 or 48 hours.

Cell counts were made on cultures prior to dilution and freezing. Final dilutions ranged from 7,500 to 50,000 organisms per ml.

The frozen samples were maintained at –73° C. to –79° C. for periods varying from one to 125 days.

Following thawing, the samples were immediately inoculated into CPLM medium. These samples were then incubated at 37° C. and daily microscopic examinations made for motility for a maximum period of seven days.

RESULTS

Up to the present time, 20 samples in plain milk and 18 samples in glycerinated milk have been thawed and cultured in CPLM medium.

From the results shown in Table 1, there were 13 positive recoveries from plain milk samples and only 8 positive recoveries from glycerinated milk. It would appear that culture TFR was the most resistant to freezing of the four cultures used.

Although the ratio of culture to milk extender varied from 1:10 to 1:25, there seemed to be no correlation between concentration and survival rate. One trial was run in which cultures TFR and TFP were washed and suspended in physiological saline before freezing. These TFR cultures were positive in both plain and glycerinated milk while TFP cultures remained negative throughout.

DISCUSSION

Due to the increasing use of frozen semen in artificial insemination during this past year and the possibility of the spread of tricho-

TABLE 1—Comparative recovery of trichomonads from samples frozen in plain and glycerinated milk

Bull	Plain Milk		Glycerinated Milk	
	Positive	Negative	Positive	Negative
TFR	10	1	7	4
TFP	0	2	0	2
TFM	1	2	1	2
TFB III	1	1	0	2

moniasis from semen of infected bulls in artificial breeding studs, it was felt advisable to investigate the value of deep-freezing as a possible method of destroying *Trichomonas fetus* in semen of infected bulls.

According to the limited results obtained in this preliminary investigation, it would appear that the use of glycerinated milk is more detrimental to the recovery of *T. fetus* than is plain milk. At this time, it is not possible to draw valid conclusions on this point due to mechanical difficulties in handling and freezing of samples on two occasions.

Despite the fact that our results have not been consistent, there is strong evidence to indicate that one cannot rely on deep-freezing of semen samples from infected bulls to destroy trichomonads which may be present.

CONCLUSIONS

The results of these experiments indicate that:

Trichomonas fetus can survive in prepared milk semen extender.

Trichomonas fetus can survive in milk extender frozen to –79° C. and maintained at that temperature for as long as 125 days.

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NOTES ON NEW PEACH VARIETIES

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The South Haven Experiment Station has been receiving many inquiries about several new peach varieties, especially concerning Dixired, Dixigem, Southland, Redglobe and Redskin.

The first three varieties originated at the U. S. Horticultural Field Laboratory at Fort Valley, Georgia, and have been very helpful to the southern peach industry. Redglobe was released just a few months ago from the U.S.D.A. Plant Industry Station at Beltsville, Maryland. Redskin was introduced a few years ago by the University of Maryland.

These varieties have all been under test at the South Haven Experiment Station for several years. Following are notes on their behavior in the station trial orchard:

Dixired. Matures about 10 days earlier than Redhaven. Fruits are small, very dark red and completely clingy.

Dixigem. Matures about three days earlier than Redhaven. Moderately good production record at South Haven. Medium in size. Flesh quite soft.

Southland. Matures about with Halehaven. Very attractive peach of good quality. Unfortunately, it has been unproductive at South Haven and at some other places in northern states.

Redglobe. Matures about four days before Halehaven. The fruits are of medium-large size, bright red color, and the flesh characteristics are excellent. However, the variety has produced only one full crop at South Haven in the four years since coming into production. There is some evidence that it is bud tender in northern areas.

Redskin. Matures almost with Elberta and competes on the market with that variety. Fruits of Redskin are medium to small in size, have considerable red color, and the flesh is firm and of good flavor. Experience at South Haven and reports from other northern states indicate

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that small fruits may be the principal weakness of this variety. If fruits of good size can be grown, Redskin may prove to be a valuable variety.

In fairness to these varieties, it should be emphasized that they originated where climatic conditions are considerably different than those found in Michigan. Dixired, Dixigem, and Southland have all been valuable varieties in the far south. Redskin has been successful in its native state of Maryland, and Redglobe, although introduced within the year, has made a good trial record in Maryland and in California. It should also be remembered that varieties originating in Michigan have not made very good records in Georgia.

A number of other new varieties have been introduced in eastern and southern states so recently that there has not been enough time to test them in Michigan. Some of these varieties include Cardinal, Coronet, Tulip, Redcap, Ranger, Keystone, Southern Glow, Romance, Fireball, Loring, Ozark, Poppy, and Blake.

There is considerable interest among Michigan peach growers in a suitable variety maturing a week or more earlier than Redhaven, and in a variety of brighter color and firmer flesh ripening in Halehaven season. The Michigan Agricultural Experiment Station is nearly ready to announce the release of a new variety for trial in each of these seasons.

It is always a safe rule for the fruit grower to plant only a few trees of a new variety until it has been tested long enough to be truly evaluated. The chances of a new variety reaching commercial status are very slight. Less than two percent of newly introduced peach varieties tested at the South Haven Experiment Station during the last 30 years have become commercially important in the state. Therefore, the chances of a grower making a commercial success of planting large numbers of trees of a newly introduced variety are likewise very slight. It is much wiser to keep planting varieties of known value until the new ones have been well tested.

CHEMICAL FLY CONTROL

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FLIES CONTINUE to be a major problem in Michigan dairy barns, and the Michigan State College campus is not immune to this problem. In 1954, as in 1953, the campus barns provided adequate testing grounds for a number of new methods and materials for fly control.

The cooperative project described in this paper was a continuation of the work reported in Article 36-22 of the November, 1953, issue of this Bulletin (King, Guyer and Ralston, 1953). The same 10 barns (7 used by the M.S.C. Dairy Department and 3 used by the Michigan Artificial Breeders Association) were used. A tabular description of these barns may be found by referring to the article cited above.

The general plan of the project was to start a different method of fly control in each barn and to continue it until a satisfactory appraisal of its effectiveness could be made. Since this time varied with different methods, a regular rotation of treatments was impossible, but an attempt was made to try each method in more than one barn. Fly counts, involving from 3 to 15 stations per barn, were made twice a week in four of the barns. All barns were visited twice a week and observations made as to the effectiveness of the treatments. Herdsmen were interviewed frequently and their observations recorded.

Through the cooperation of Mr. George F. Mallison, of the U. S. Public Health Service, two methods of fly control were tried at the experimental garbage disposal unit, located near the sewage disposal plant on E. Kalamazoo street. The results of Mr. Mallison's work are included in this report.

Table 1 lists the commercial materials and machines provided by various companies for experimental use in 1954. The treatments used may be grouped into the following classes:

1. Residual sprays on walls and ceilings; 2. Floor treatments; 3. Dry baits; 4. Painted-on baits; 5. Parathion-treated cords; 6. Space sprays; 7. Direct spraying of cattle; 8. Sanitation.

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*TABLE 1—Materials and machinery used in fly control project**

Material	Source
Wettable powders	
25% diazinon	Geigy Company, New York, N. Y.
25% chlorthion	Chemagro Corporation, New York, N. Y.
Penthion "40", containing Crag Fly Repellent 30% and malathion 10%	S. B. Penick and Co., New York, N. Y.
Liquid sprays or concentrates	
25% parathion emulsifiable	American Cyanamid Co., New York, N. Y.
57% malathion emulsifiable	American Cyanamid Co., New York, N. Y.
25% "4124" emulsifiable	American Cyanamid Co., New York, N. Y.
44% chlorthion emulsifiable	Chemagro Corporation, New York, N. Y.
Crag-Thanite mixture, with Crag Fly Repellent 32% and Thanite 24%	Hercules Powder Co., Wilmington, Del.
Banafly Pyrenone Emulsion Conc., containing pyrethrins 1% and piperonyl butoxide 10%	American Scientific Laboratories, Inc., Madison, Wis.
Penthion "80" emulsifiable, containing malathion 20% and Crag Fly Repellent 60%	S. B. Penick and Co., New York, N. Y.
Pyrocide Automatic Sprayer Conc., containing pyrethrins 1% and MGK 264 synergist 10%	McLaughlin Gormley King Co., Minneapolis, Minn.
F-21 emulsifiable, containing Crag Fly Repellent 50% and methoxychlor 5%	Carbide and Carbon Chemical Corp., New York, N. Y.
F-22 emulsifiable, containing Crag Fly Repellent 53.2% and malathion 5.2%	Carbide and Carbon Chemical Corp., New York, N. Y.
Stockaid Animal Spray, containing pyrethrins 0.03% and piperonyl butoxide 0.24%	Rex Research Corp., Toledo, Ohio
E-Z-Flo Pyrenone Stock Spray Concentrate, containing pyrethrins 1% and piperonyl butoxide 10%	E-Z-Flo Chemical Co., Lansing, Mich.
Difuso pyrethrum spray (pre-war formulation originally containing about 0.6% pyrethrins)	The Tanglefoot Company, Grand Rapids, Mich.
Bait materials	
Dipterex, technical (Bayer L 13/59)	Chemagro Corporation, New York, N. Y.
Dipterex-199, containing 1% Bayer L 13/59	Pittsburgh Coke and Chemical Co., Pittsburgh, Pa.
Fasco Fly Flakes, containing 1% malathion	Florida Agricultural Supply Co., Jacksonville, Florida
Diazinon Fly Bait (1% diazinon)	Geigy Company, New York, N. Y.
Ortho Dry Bait (2% malathion)	California Spray-Chemical Corp., Elizabeth, N. J.

TABLE 1—Continued

Material	Source
12-ounce aerosol bombs	
Pressurized Livestock Spray 216-L, containing pyrethrins 0.2%, sulfoxide 2.0%, thanite 2.0% and methoxychlor 3.0%	S. B. Penick and Co., New York, N. Y.
Penthion Pressurized Livestock Spray, containing pyrethrins 0.2%, sulfoxide 1%, malathion 0.5% and Crag Fly Repellent 10%	S. B. Penick and Co., New York, N. Y.
PS-15 Pressurized Spray containing pyrethrins 0.16%, Crag Fly Repellent 16.37% and sulfoxide 1.65%	Carbide and Carbon Chemical Corp., New York, N. Y.
Treadle Sprayers	
Banafly Automatic Cattle Sprayer.....	American Scientific Laboratories, Inc., Madison, Wisconsin
Yellow Devil Model 69 Automatic Cattle Sprayer	Engine Parts Manufacturing Co., Cleveland, Ohio
Space Sprayers	
Tanglefoot Industrayer.....	The Tanglefoot Company, Grand Rapids, Mich.
Microsol—Model 202.....	Silver Creek Precision Corp., Silver Creek, N. Y.

*All of the machines and most of the chemicals mentioned were provided by the companies listed.

RESIDUAL SPRAYS ON WALLS AND CEILINGS

As in 1953, residual sprays were applied with a John Bean Spartan portable power sprayer, operated at 100 pounds pressure. Enough spray was applied to wet the surface but not enough to run. The operator wore protective clothing and a respirator during the spraying operation.

Five dairy barns were used in the study of the effectiveness of residual sprays. Five materials in six formulations were applied with and without Karo syrup. In four of the barns, fly counts were made twice a week. Data taken from the herdsmen in charge of each barn were also employed in making determinations regarding the effectiveness of the materials. The results are outlined in Table 2.

The Penthion formulations, which combined malathion and Crag Fly Repellent, gave only fair control for a week. There was no detectable difference in the control which resulted when Penthion wettable powder was compared with the emulsifiable material at the same concentration. Malathion killed flies effectively for three weeks in

TABLE 2—Formulation, concentration and effectiveness of residual sprays

Location	Date	Formulation	Concentration applied	Effective time
Garbage disposal	All season	57% malathion emul...	1% malathion.....	21 days
Main barn	6/10	57% malathion emul...	1% malathion.....	20 days
	7/1	57% malathion emul...	1% malathion.....	22 days
	7/29	57% malathion emul. and Karo syrup	1% malathion and 2% Karo	26 days
	8/30	25% "4124" emulsion and Karo syrup	1% "4124" and 2% Karo	29 days
Large bull barn	6/10	57% malathion emul. and Karo syrup	1% malathion and 2% Karo	20 days
	7/29	44% chlorthion emul. and Karo syrup	1% chlorthion and 2% Karo	28 days
Experimental barn	6/10	Penthion "40" W. P...	32 lb./100 gal.....	8 days
	6/29	Penthion "80" emul....	2 gal./100 gal	7 days
	7/7	57% malathion emul. and Karo syrup	1% malathion and 2% Karo	19 days
	8/3	25% "4124" emulsion and Karo syrup	1% "4124" and 2% Karo	28 days
Small bull barn	6/29	44% chlorthion emul...	1% chlorthion.....	Bulls removed. No data.
Biebesheimer barn	7/7	25% "4124" emulsion..	1% "4124".....	33 days
A. B. A. Barn 1	8/27	25% diazinon W. P. and Karo syrup	1% diazinon and 2% Karo	28 days

each of three barns as well as in the garbage composting room. Control with malathion was very satisfactory during the first two weeks after application, but declined rapidly after this time.

Diazinon, chlorthion and experimental insecticide 4124 continued to kill flies satisfactorily for four weeks. In one barn where experimental insecticide 4124 was used, many flies were killed eight weeks after the application had been made. Comparable results were evident with chlorthion.

A yellow residue resulted after the chlorthion and experimental insecticide 4124 sprays had dried, but did not appear to be extensive enough to be objectionable. The addition of Karo syrup to the residual sprays appeared to prolong the effectiveness of the spray about 10

percent. It was questionable whether the addition of Karo syrup increased the attractiveness of the spray.

At this time, diazinon, chlorthion and experimental insecticide 4124 have not received Federal approval for use in dairy barns. Lindane and methoxychlor were found to be relatively ineffective for control of flies during 1953 and were not included in the 1954 experimental program.

FLOOR TREATMENTS

Floor treatments were used in three barns. Malathion and Dipterex (Bayer L 13/59) were used in combination with Karo syrup and water. The malathion floor bait consisted of 1 cup of 57 percent malathion emulsion and 1 cup of Karo syrup in 3 gallons of water. The Dipterex bait was composed of ¼ teaspoon of technical grade Dipterex and 1 cup of Karo syrup in 3 gallons of water. The mixtures were applied to the barn floor with a sprinkling can.

The malathion bait, when applied to a clean cement floor, remained effective from six to eight days. The Dipterex bait lasted only two to three days, but the initial kill with the Dipterex bait was greater than with the malathion bait treatment. The advantages and disadvantages of the floor treatment technique for fly control were outlined in the 1953 report. It was apparent during the 1954 study that satisfactory fly control, using the floor treatment technique, could be expected only under ideal sanitation conditions.

DRY BAITS

Because of increased interest in the dry bait technique for fly control, an experiment was established to evaluate the effectiveness of various dry baits. Three materials in four formulations were compared. Fifty grams of each bait was placed in a white enamel pan. A series of pans, along with a pan containing fifty grams of sugar and an empty pan, were placed in each of two dairy barns. In one barn the flies were counted and removed daily, and in the other every other day. The pans were rotated after each count. The materials and their ranking as to the number of dead flies in the pans are presented in Table 3.

This ranking of materials is based only on the number of dead flies in the pans and does not take into consideration those flies which died after leaving the pan. Observations made during the experi-

TABLE 3—The dry baits and their ranking

Material	Rank	Mean No. killed/ 24 hours*
Dipterex 199 (L 13/59, 1%).....	1	329
Fly Flakes (1% malathion).....	2	180
Ortho Fly Killer (2% malathion)..	3	140
Diazinon (1%).....	4	56
Sugar.....	5	23
Empty.....	6	13

*Based on 19 collecting periods.

ment seemed to indicate that flies died quicker after feeding on the Dipterex bait than on the other materials. This might be partially responsible for the high ranking of the Dipterex bait. It was apparent, however, that the Dipterex bait did attract larger concentrations of flies than any of the other materials. Fly Flakes ranked second when actual numbers of dead flies were compared, but there was no significant difference between the kill with Fly Flakes and the Ortho Fly Killer. Diazinon was much less effective than the other materials.

When conditions of high humidity existed, the Dipterex and diazinon baits rapidly absorbed moisture and made an undesirable sticky residue. After the diazinon bait had absorbed moisture, it appeared to lose most of its toxicity and left a serious brown stain wherever the bait had been. The Dipterex bait appeared to increase in attractiveness after it had absorbed moisture.

The baits were also used, as directed, in three of the dairy barns. It was immediately apparent that in conventional dairy barns where the floors are swept daily and good sanitation practices are employed, there are very few locations where dry baits can be used successfully. In loose housing arrangements, there may be areas where dry baits would be applicable.

PAINTED-ON BAITS

Baits prepared with Karo syrup and Bayer L 13/59 (Dipterex, technical grade) as described by Bruce[1] were applied to painted surfaces in three barns and a milkhouse. The bait was painted on exposed areas where flies were observed to congregate. In the barns where

[1]Bruce, W. N. (1953). A new technique in control of the house fly. Illinois Natural History Survey Biological Notes No. 33.

the bait treatment was used, the material continued to kill flies satisfactorily for two to three weeks. After three weeks, the bait became covered with a deposit of dust and debris and was relatively ineffective.

When the bait was painted on the underside of light fixtures in barns, it remained effective for four weeks. In the milkhouse the bait treatment gave satisfactory control for less than 16 days. There was no indication that control with the Bayer bait was effective more than four weeks.

PARATHION-TREATED CORD

Parathion-treated cords were used by Mr. George F. Mallison in the utility building at the garbage composting unit. The building was not screened and had a continuous fly population attracted by the garbage in the adjacent building. The garbage and compost were manipulated so that flies did not emerge from it, but many flies were attracted to it. Cotton cord of ⅛ inch diameter was soaked in a xylene solution of 10 percent parathion and then allowed to dry. The cord was then strung from one rafter to another at 8-foot intervals. The treated cords provided satisfactory fly control for the entire season with only one treatment of the cord.

This is in agreement with Mr. Mallison's previous experiences with the Public Health Service and with the results reported from Denmark by Wichmand[2]. It should be pointed out, however, that the preparation of the cords is extremely hazardous and should be undertaken only by persons familiar with the dangers involved.

SPACE SPRAYS

Space sprays were used in the milking parlor and milkhouse of two loose housing barns. The Industrayer was used in one barn and the Microsol machine was tested in the other. Even though the milking parlors and milkhouses were screened, flies would enter the milking parlors on the cows, and concentrated fly populations would build up during each milking.

After milking was completed, the machines were allowed to run 10 to 15 seconds in each room. Emulsifiable methoxychlor-Crag fly repellent 1-10, diluted 1 to 9, was used in one barn; and Difuso pyre-

[2]Wichmand, H. (1953). Control of multi-resistant houseflies. Nature 172: 758.

thrum spray was used in the other. Both machines and both formulations gave satisfactory fly control and were well received by the herdsmen using them.

DIRECT SPRAYING OF CATTLE

The direct spraying of dairy cattle in the barns and beef cattle in the pasture was accomplished using the following methods: 1. Treadle-type automatic sprayer; 2. two-gallon compressed-air sprayer; 3. one-quart hand sprayer; 4. Microsol machine; 5. Aerosol bombs.

Two treadle-type automatic sprayers were installed at the Rose Lake Experiment Station. The Yellow Devil Model 69 and the Banafly automatic cattle sprayer were installed so that the cattle would pass through the sprayer going to and from the drinking water. Each sprayer served a herd of 30 beef cattle, and a third herd of equal size was maintained as a control herd.

It was not possible to make actual fly counts on the animals, but observations were made by the herdsmen and members of the staff on mechanical operation of the machines and effectiveness of formulations used.

Both of the automatic sprayers operated satisfactorily during the entire fly season after preliminary mechanical adjustments were made. The Banafly sprayer was set up with the factory-made metal hood, while the Yellow Devil unit was located in a chute built of six fence poles with a canvas over the sides and top. A two-week adjustment period was necessary to accustom the cattle to the Banafly sprayer with the hood in place.

When the "homemade" chute was used, the cattle appeared to be adjusted to the sprayer after two days. It is possible to purchase the Banafly sprayer without the metal hood and use the "homemade" chute arrangement. When a herd of more than 20 head use the sprayer, it might be desirable to increase the capacity of the tank which holds the insecticide.

The four formulations used in the automatic sprayers were: 1) Banafly, 2) E-Z-Flo, 3) Crag-thanite mixture, and 4) Pyrocide. All of the formulations gave a substantial reduction of the fly population in the treated herd when compared with the control herd. The herds with fly control were observed to be much less restless than the control herd during the periods of maximum fly concentrations.

The direct spraying of cattle was undertaken in three barns. A

two-gallon compressed-air sprayer, a one-quart hand sprayer and a Microsol machine were used. Emulsifiable methoxychlor-Crag 1-10, diluted 1 to 9 and 1 to 5 with water, was sprayed directly on calves and milking cows. The 1 to 9 dilution was used in the compressed-air sprayer and ½ to 1 pint of spray was applied per animal. This treatment was effective in controlling flies for 3 to 5 days when heavy infestations were present. The 1 to 5 dilution was used in the hand sprayer and the Microsol machine applying sufficient material to cover all parts of the animal.

A smaller quantity of actual toxicant was applied per given area of animal with the hand sprayer and the Microsol machine than with the compressed-air sprayer, and the period of fly protection was correspondingly shorter. The hand sprayer and Microsol machine gave satisfactory control for 1 to 2 days. One application of malathion-Crag 1-10 diluted 1 to 9 with water, was sprayed at the rate of ½ pint per calf on three animals. This formulation gave excellent initial kill and satisfactory control for 5 days. At this time, malathion has not been given Federal approval for direct application on animals.

In the experimental barn calf-pens, 12-ounce aerosol bombs were used for direct application of insecticides. Each calf was sprayed from 10 to 12 seconds with the aerosol. Control calves were maintained adjacent to the sprayed animals. The three formulations used were pyrethrin-sulfoxide-Crag, pyrethrin-methoxychlor-thanite-sulfoxide and a Penthion compound. Both the pyrethrin-sulfoxide-Crag and the pyrethrin-methoxychlor-thanite mixture gave satisfactory control for 1 to 2 days, depending on the density of the fly population. The Penthion aerosol gave satisfactory initial kill but provided little residual control.

SANITATION

A serious infestation of both house flies and stable flies developed in grass silage during the summer of 1954. This infestation provided a reservoir of adult flies which made a satisfactory fly control program almost impossible in the surrounding units. A complete discussion of this silage-fly relationship will be presented in a future publication. One apparent conclusion which resulted from the rapid build-up of flies in grass silage was the need for more emphasis on sanitation. This sanitation program should include not only careful handling of grass silage but also the proper disposal of manure. With so many new and

highly efficient insecticides and numerous methods of application, it appears that general sanitation practices have been neglected.

Stable fly infestations were extremely serious during 1954 in all of the barns studied. Many of the techniques which are successful in controlling house flies are useless in controlling stable flies. A successful fly control program should not be based on any single method of control, but should be handled with all of the tools at hand and correlated closely with a good sanitation program.

SUMMARY

A cooperative fly control project involving 10 M.S.C. dairy barns, three beef herds at the Rose Lake Experiment Station and the M.S.C. garbage composting unit was conducted during the summer of 1954. The following conclusions were obtained:

1. In conventional dairy barns, residual sprays of diazinon, chlorthion and experimental insecticide 4124 continued to kill flies satisfactorily for 4 weeks. Residual sprays of malathion were satisfactory for 3 weeks.

2. Floor treatments, dry baits, painted-on baits, treated cords and space sprays were tested and the results indicated that each of these techniques offered useful means of fly control under restricted conditions.

3. Satisfactory fly control by direct spraying of cattle was accomplished using treadle-type automatic sprayers, compressed-air sprayers, hand sprayers, a Microsol machine and aerosol bombs. The mechanical manipulation of the machines and the fly control achieved by the direct spraying of cattle is discussed.

4. It was apparent during the 1954 study that good fly control resulted only when effective sanitation practices were combined with a satisfactory chemical control program.

MICHIGAN FARM BUSINESS REPORT FOR 1953

By JOHN C. DONETH

COOPERATIVE EXTENSION SERVICE AND THE AGRICULTURAL ECONOMICS DEPARTMENT

THE EARNINGS of Michigan farmers were further reduced in 1953. This was generally true for all types of farmers except those producing fruit. This information was obtained from the farm records of 501 farmers distributed throughout 72 Michigan counties. These farm accounts were kept as a part of the Cooperative Extension Program of the county agricultural agents and were summarized under the supervision of the extension specialists in the agricultural economics department.

This report summarizes by type-of-farming areas the financial position of these cooperating farmers in 1953, and compares some selected income and expense items with those of previous years.

FARM EARNINGS

Gross incomes decreased slightly, expenses continued to climb, and farm investments continued to increase. The percentage of record keeping farmers who went "in the red" in 1953 was the highest it has been for 16 years. Of the 501 farms studied, 20 percent had labor incomes of zero or less. There were 66 percent who had labor incomes of $1,001 or more. This was the lowest figure for this group in 13 years (Table 1).

While the figures in this report reveal in a general way what is taking place on Michigan farms, they should not be interpreted as representing the average farmer. These account farms averaged 224 acres in size, compared to the average sized Michigan farm of 111 acres. These were not only larger farms but they were also operated by better-than-average farmers. All of the farmers subscribed to good bookkeeping and had their farm businesses analyzed by the department.

The earning figures between various years are not entirely comparable. The sample changes slightly from year to year. However,

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some reasonably good comparisons between years can be made. In making comparisons, it should be recognized that relatively fixed values are used on land, improvements and breeding stock. These have not sufficiently reflected the change that has occurred in farm investment market values.

The average return of these record keeping farmers for their labor and management was $2,447 per farm in 1953 (Table 2). This was a 16 percent decline from 1952 and represented a 35 percent drop since 1951. The earnings in 1951 were the highest dollar-wise that farmers have obtained in the last 25 years of record keeping in Michigan. Farm earnings are still well above the long-time average.

This represents the second general decline since the end of World War II. The first decline started in 1947 and continued until the Korean Military Action in 1950. For the next couple of years, the farm income situation improved. However, since mid-1952 farm incomes have generally been falling. The second decline has occurred in spite of high employment and heavy industrial production. The

TABLE 1—Percentage and distribution of labor incomes, by years, 1936-1953

Year	Total number of farms	Farms in each labor income group		
		0 or less	$1 to $1,000	$1,001 and over
		Percent	Percent	Percent
1936	1,055	6	43	51
1937	1,163	22	54	24
1938	1,252	20	57	23
1939	1,346	14	54	32
1940	1,263	12	55	33
1941	1,041	5	27	68
1942	1,160	2	18	80
1943	1,097	8	24	68
1944	1,031	5	18	77
1945	939	6	17	77
1946	838	4	9	87
1947	830	5	11	84
1948	846	8	15	77
1949	912	9	16	75
1950	826	11	17	72
1951	685	7	9	84
1952	551	13	11	76
1953	501	20	14	66
18-year average	963	10	26	64

TABLE 2—Farm earnings on farm accounting farms in Michigan, by years, 1929-1953

Year	Labor income	Year	Labor income
1929	$ 585	1941	$1,675
1930	−263	1942	2,303
1931	−676	1943	1,990
1932	−595	1944	2,406
1933	249	1945	2,483
1934	565	1946	3,374
1935	764	1947	3,486
1936	1,318	1948	2,735
1937	569	1949	1,815
1938	571	1950	2,688
1939	780	1951	3,782
1940	787	1952	2,926
		1953	2,447
25-year average (1929-53)			$1,550

falling off of some of our markets abroad, coupled with record agricultural production, provided more produce than was demanded at existing prices, and thus prices fell.

The general decline in farm prices caused not only reduced cash sales but also caused lower inventory prices to be used at the end of the year by many of the farm account cooperators in their record books. Thus, labor income was reduced.

Labor income represents what the farmer has left for his labor and management after all cash expenses, depreciation, family labor, and 5 percent interest on the investment have been subtracted from the gross income. In addition, the farm operator receives the value of farm products used from the farm in the home. This figure continues to grow smaller with each passing year.

The drop in gross income from 1952 to 1953 was only slight. However, even a slight decrease in gross income when coupled by a small increase in expenses tends to have a rather serious effect on the net earnings (Table 3). Every item of farm expense, except purchased feed, was higher in 1953 than for the previous year. It might also be said that each expense item was higher than for any previous year, except the item of feed. There was no less feed bought in 1953, but prices were lower. As farmers continue to operate on this high cost level, earnings can be maintained only by keeping the gross income level high.

The physical side of farming has also undergone changes (Table 4). Since 1947, the average size farm has increased from 134 to 160 tillable acres per farm. The number of animal units has increased about one-third. In the meantime, the labor force has changed very little.

TABLE 3—Comparison of gross income, expenses and labor incomes on farm accounting farms in Michigan, by years, 1947-1953

Item	1947	1948	1949	1950	1951	1952	1953
INCOME							
Crops	$ 2,663	$ 2,223	$ 2,085	$ 2,372	$ 2,646	$ 2,872	$ 3,143
Dairy products	3,456	3,671	3,274	3,439	4,574	5,410	5,676
Cattle	1,082	1,209	1,094	1,719	2,165	1,666	1,055
Hogs	949	725	643	865	1,034	952	1,038
Poultry and eggs	805	827	782	810	992	995	1,131
Sheep	126	102	104	151	187	95	113
Other	351	415	387	447	497	526	289
	$ 9,432	$ 9,172	$ 8,369	$ 9,803	$12,095	$12,516	$12,445
EXPENSES							
Feed bought	$ 1,231	$ 1,190	$ 1,062	$ 1,192	$ 1,502	$ 1,726	$ 1,634
Machinery	1,162	1,365	1,497	1,658	1,939	2,253	2,445
Hired labor	634	665	628	684	739	888	929
Crop expense	770	863	877	774	1,111	1,303	1,395
Family labor	468	509	469	449	487	467	485
Improvements	349	373	422	454	526	617	667
Taxes	128	138	146	168	185	223	241
Other	216	255	285	482	427	502	530
	$ 4,958	$ 5,358	$ 5,386	$ 5,861	$ 6,916	$ 7,979	$ 8,326
Net farm income	4,474	3,814	2,983	3,942	5,179	4,537	4,119
Interest on investment at 5%	988	1,079	1,168	1,254	1,397	1,611	1,672
LABOR INCOME	$ 3,486	$ 2,735	$ 1,815	$ 2,688	$ 3,782	$ 2,926	$ 2,447

TABLE 4—Comparison of size of farm, amount of livestock and amount of work, 1947-53 by years, Michigan

Item	1947	1948	1949	1950	1951	1952	1953
Number of farms	830	846	912	826	685	551	501
Total acres	193	196	198	201	210	223	224
Tillable acres	134	136	136	318	146	156	160
Animal units	27.1	23.9	25.6	31.7	31.6	36.3	36.4
Man work units*	473	466	477	493	529	562	593
Number of men*	1.7	1.7	1.7	1.6	1.7	1.7	1.6
Work units per man*	286	281	292	303	319	306	360

*Fruit farms excluded.

TYPE-OF-FARMING AREA INFORMATION

The figures and information already presented pertain to an average of all farm account farms throughout the state. In addition to state average figures, the following tables, 5, 6, 7 and 8, show information for 10 type-of-farming districts in the state. Some areas have been combined this year for the first time so that the results are represented by districts rather than by each individual type of farming area. The data presented includes a financial summary; the kinds of crops grown, their yields, and the percentage of tillable land in each crop; the kinds, amounts and returns from livestock; and the various expenses and their relationships to each other. Figure 1 shows the counties included in each so-called district.

AREA	NAME
1.	Corn and Livestock
2.	Small Grains and Livestock
3.	Southwestern Fruit and Truck Crops
4.	Poultry, Dairy and Truck Crops
5.	Dairy and General Farming
6.	Dairy and Cash Crops
7.	Dairy, Hay and Special Crops
8.	Beans, Sugar Beets, and Dairy
9.	Cattle, Sheep, and Forage
10.	Central Potato and Dairy
11.	Northern Fruit and Dairy
12.	Northern Potato and Dairy
13.	General, Self-Sufficing, and Part-Time
14.	Cattle, Potatoes, and Self-Sufficing
15.	Cattle, Hay, and Spring Grains
16.	Dairy and Potatoes
17.	Potatoes, Dairy, and Part-Time

Fig. 1. Type-of-farming Areas in Michigan.

TABLE 5—Financial summary of 501 Michigan farm account farms by type-of-farming area, 1953

Item	All farms	Type-of-farming area									
		1	2	3, 11	4	5	6, 7	8	9, 12, 14	10	15, 16, 17
Number of farms	501	64	39	27	25	116	48	42	63	35	42
Total acres	224	211	249	175	167	243	231	180	264	225	204
Percent of farm acres tillable	71	81	82	73	76	75	81	77	56	62	51
Tillable acres	160	170	205	128	127	183	187	138	148	140	104
Real estate (less house)	$16,690	$17,732	$19,236	$19,201	$12,246	$20,345	$19,134	$20,472	$10,575	$11,197	$ 8,073
Machinery and equipment	7,461	7,553	8,460	7,029	7,316	8,658	7,869	7,769	6,093	6,824	5,273
Livestock	5,456	6,379	7,192	8,426	4,546	6,852	6,144	4,732	4,363	4,375	3,118
Feed and crops	3,778	4,886	5,036	2,883	3,712	5,162	3,655	4,191	2,045	2,182	1,272
Capital investments*	$33,385	$36,550	$39,924	$37,539	$27,820	$41,017	$36,802	$37,164	$23,076	$24,578	$17,736
Livestock income	8,688	9,395	11,916	4,127	10,257	10,785	9,336	8,405	6,114	7,230	5,425
Crop income	3,143	3,966	3,000	17,408	782	2,629	2,081	4,695	978	1,345	238
Other income	614	575	755	729	346	633	444	713	549	551	684
Gross income	$12,445	$13,936	$15,671	$22,264	$11,385	$14,047	$11,861	$13,813	$ 7,641	$ 9,126	$ 6,347
Total expense†	8,326	8,826	11,533	14,986	8,080	8,997	8,479	8,552	5,191	6,360	4,545
Net farm income	4,119	5,110	4,138	7,278	3,305	5,050	3,382	5,261	2,450	2,766	1,802
Less interest at 5%	1,672	1,827	1,996	1,876	1,391	2,051	1,840	1,858	1,154	1,229	886
Labor income 1953	2,447	3,283	2,142	5,402	1,914	2,999	1,542	3,403	1,296	1,537	916
Labor income 1952	2,926	2,984	2,916	3,860	2,930	3,589	3,103	3,742	1,826	2,485	1,797
Labor income 1951	3,782	4,533	4,845	2,765	3,752	5,173	3,633	4,726	2,309	3,233	1,888
Labor income 1950	2,688	3,389	3,309	3,239	2,885	3,687	2,041	4,057	1,148	2,300	1,364
Labor income 1949	1,815	2,079	2,160	1,065	1,927	2,647	2,538	2,955	875	1,564	610
Labor income 1948	2,735	3,954	2,903	1,962	2,930	3,014	3,151	3,777	1,938	2,517	1,782
Labor income 1947	3,486	4,596	4,300	1,930	3,753	4,710	3,328	4,501	1,926	2,391	2,134
Labor income 1946	3,374	4,337	3,169	6,007	3,011	3,312	3,205	4,413	2,253	2,485	2,460
Labor income 1945	2,483	3,432	2,464	5,051	2,710	3,228	2,558	2,978	1,558	2,226	1,608
Labor income 1944	2,466	2,719	1,452	4,684	2,409	2,496	2,727	2,940	1,776	2,393	1,624
Labor income, 10-year average, 1944-1953	$ 2,814	$ 3,531	$ 2,966	$ 3,597	$ 2,822	$ 3,486	$ 2,783	$ 3,749	$ 1,691	$ 2,313	$ 1,618

*Investment figures tend to represent long-time account book values and not present day valuations.
†Includes family labor, but not operator's labor or interest on investment.

TABLE 6—Kinds of crops and percentage of tillable land in different crops and also yields by type-of-farming area in Michigan, 1953

Item	All farms	Type-of-farming area									
		1	2	3, 11	4	5	6, 7	8	9, 12, 14	10	15, 16, 17
Number of farms	501	64	39	27	25	116	48	42	63	35	42
Number of tillable acres	160	170	205	128	127	183	187	138	148	140	104
Percent in sod crops	46	34	43	31	42	42	53	33	63	59	69
Percent in legumes	34	27	30	20	32	35	37	29	49	40	40
Percent tillable acres in:											
Tillable pasture	18	11	21	13	17	16	23	13	24	20	20
Alfalfa hay	12	11	10	11	8	11	13	13	14	18	8
Other hay	13	9	9	7	15	10	15	6	19	14	37
Corn (includes silage)	18	26	17	11	21	18	14	19	10	11	3
Wheat	...	17	17	4	16	17	12	16	4	8	1
Oats (oat mixture)	13	16	14	6	19	13	11	12	14	13	20
Beans	1	...	...	...	...	...	5	9	...	...	...
Sugar beets	...	...	...	...	...	...	...	5	...	...	...
Potatoes	...	...	...	...	...	...	1	...	1	2	1
Fruit and truck	18	...	...	41	...	...	...	...	...	...	...
Other	1	5	6	1	1	8	1	5	5	1	6
Idle	3	2	3	6	1	3	3	2	5	5	4
Grass silage	3	3	3	...	2	4	2	...	4	8	...
Crop yield per acre:											
Alfalfa hay	2.2	2.0	1.9	1.8	2.4	2.0	2.4	2.6	1.9	2.1	2.2
Other hay	1.7	1.7	1.5	1.8	2.0	2.0	1.9	1.9	1.7	1.7	1.6
Corn, shelled	56	60	43	52	58	57	58	64	42	53	...
Wheat	32	35	32	36	29	32	29	33	30	28	19
Oats	40	44	34	43	34	44	37	44	35	31	37
Beans	18	...	...	...	...	...	10	23	...	...	...
Sugar beets	...	...	...	...	...	...	...	13.8	...	...	...
Potatoes	...	...	...	...	...	...	230	...	290	337	255
Grass silage	5.9	5.4	5.6	...	5.3	7.0	5.0	...	5.5	5.5	...
Crop yield index	100	102	88	...	100	106	94	116	98	92	95
Crop sales and ASC payments	$ 2,832	$ 3,371	$ 3,214	$13,013	$ 906	$ 2,555	$ 2,121	$ 4,169	$ 1,117	$ 1,326	$ 332
Crop income, total	3,143	3,966	3,000	17,408	782	2,629	2,081	4,695	978	1,345	238
Feed bought	1,634	2,227	2,795	1,185	2,802	1,752	1,379	1,348	812	1,120	1,163

TABLE 7—Livestock: Kinds, amounts and returns from livestock by type-of-farming area in Michigan, 1953

Item	All farms	Type-of-farming area									
		1	2	3, 11	4	5	6, 7	8	9, 12, 14	10	15, 16, 17
Number of farms	501	64	39	27	25	116	48	42	63	35	42
Livestock income, total	$ 8,688	$ 9,398	$11,916	$ 4,127	$10,257	$10,785	$ 9,336	$ 8,405	$ 6,114	$ 7,230	$ 5,425
Livestock income per T.A.*	54	55	58	32	81	59	50	69	41	52	52
Productive animal units	36.4	40.0	49.9	14.6	33.8	42.0	39.0	32.0	34.0	33.0	28.0
Tillable acre per P.A.U.†	4.3	4.2	4.1	5.2	3.8	4.4	4.8	4.3	4.4	4.2	3.9
CATTLE:											
Percent farms reporting	93	86	97	78	92	91	94	95	97	97	100
Cows per farm reporting	17.3	15.5	19.1	11.1	14.6	19.3	21.7	15.8	15.6	17.5	17.1
Dairy product sales per cow	$ 327	$ 346	$ 315	$ 305	$ 324	$ 365	$ 353	$ 367	$ 261	$ 298	$ 256
Dairy sales per farm reporting	5,676	5,385	6,014	3,395	4,127	7,045	7,668	5,793	4,061	5,222	4,368
Income per farm reporting	2,734	2,637	4,198	773	3,205	2,301	3,857	2,086	3,107	3,286	409
HOGS:											
Percent farms reporting	45	67	64	...	28	52	13	52	52	37	17
Sows per farm reporting	3.3	6.0	6.3	...	3.1	4.3	2.2	2.8	2.0	1.2	2.0
Litters farrowed per farm	6.1	11.6	12.2	...	4.6	10.5	5.4	5.0	2.9	2.2	2.0
Pigs weaned per litter	6.8	6.8	7.1	...	6.6	6.5	8.6	7.4	6.5	7.8	...
Hog income per litter	$ 381	$ 339	$ 397	...	$ 432	$ 372	$ 305	$ 393	$ 236	$ 349	$ 114
Income per farm reporting	2,310	3,272	4,993	...	1,432	2,842	1,373	2,143	686	357	147
SHEEP:											
Percent farms reporting	12	16	21	...	...	20	8	10	11	...	...
Ewes per farm reporting	46	19	62	...	...	55	59	19	54	...	...
Lambs raised per 100 ewes	98	103	121	...	...	102	93	65	87	...	...
Sheep income per ewe	$ 21	$ 25	$ 22	...	...	$ 23	$ 27	$ 19	$ 16	...	...
Income per farm reporting	975	492	1,371	...	...	1,125	1,544	369	845	...	...
POULTRY:											
Percent farms reporting	63	72	51	59	92	64	63	69	57	49	55
Hens per farm reporting	188	234	243	187	516	173	119	121	79	188	132
Egg sales per hen	$ 6.53	$ 6.56	$ 6.81	$ 6.72	$ 7.49	$ 6.97	$ 6.07	$ 5.37	$ 6.43	$ 7.46	$ 7.48
Egg sales per farm reporting	1,243	1,681	1,654	1,255	3,862	1,204	725	648	623	1,402	991
Income per farm reporting	562	299	203	242	554	1,163	166	288	322	84	102

*T.A.—Tillable acre. †P.A.U.—Productive animal unit.

TABLE 8—Expenses and efficiency factors, labor, machinery, improvements, and other costs by type-of-farming area in Michigan, 1953

Item	All farms	Type-of-farming area									
		1	2	3, 11	4	5	6, 7	8	9, 12, 14	10	15, 16, 17
Number of farms	501	64	39	27	25	116	48	42	63	35	42
Gross income per T.A.	$ 78.00	$ 82.00	$ 76.00	$174.00	$ 89.00	$ 77.00	$ 63.00	$100.00	$ 52.00	$ 65.00	$ 61.00
Total expense per T.A.*	61.00	60.52	63.53	128.29	75.49	57.17	53.15	72.56	43.74	55.61	55.88
Total expenses*	9,756	10,297	13,013	16,410	9,611	10,482	9,944	10,012	6,453	7,794	5,829
Man labor:											
Number of men	*1.6	1.6	1.9	3.0	1.7	1.7	1.8	1.7	1.6	1.5	1.4
Income per man	$ 7,243	$ 8,919	$ 8,042	$ 7,468	$ 6,592	$ 8,430	$ 6,462	$ 8,288	$ 4,912	$ 6,130	$ 4,399
Days of work per man†	360	392	370	...	342	395	351	338	316	346	314
Hired	$ 929	$ 581	$ 1,341	$ 4,402	$ 824	$ 769	$ 984	$ 855	$ 330	$ 692	$ 456
Family	485	526	518	453	417	461	617	591	554	314	305
Operator	1,430	1,472	1,480	1,424	1,531	1,485	1,465	1,460	1,262	1,434	1,284
Expense per T.A.	17.78	15.16	16.30	49.09	21.78	14.81	16.39	21.06	14.55	17.41	19.60
Power and Machinery:											
Investments	$ 7,553	$ 7,553	$ 8,460	$ 7,029	$ 7,316	$ 8,658	$ 7,869	$ 7,769	$ 6,093	$ 6,824	$ 5,273
Income per $1000 investment	1,648	1,845	1,852	3,167	1,532	1,272	1,507	1,778	1,254	1,337	1,204
Annual expense	2,445	2,375	3,092	3,541	1,897	2,815	2,582	2,616	1,851	2,077	1,422
Expense per T.A.	15.28	13.96	15.09	27.68	14.90	15.35	13.80	18.96	12.54	14.82	13.63
Improvements:											
Investment (less house)	$ 8,234	$ 8,983	$10,194	$ 7,503	$ 6,774	$10,563	$ 9,521	$ 9,957	$ 5,003	$ 5,743	$ 4,167
Investment per P.A.U.	226	222	205	...	201	253	247	309	148	174	145
Annual expense	667	722	800	1,120	560	831	645	749	356	472	348
Expense per T.A.	4.17	4.24	3.90	8.76	4.40	4.53	3.45	5.43	2.41	3.37	3.34
Feed bought	$ 1,634	$ 2,227	$ 2,795	$ 1,185	$ 2,802	$ 1,752	$ 1,379	$ 1,348	$ 812	$ 1,120	$ 1,163
Crop expense	1,201	1,358	1,745	3,176	754	1,218	1,132	1,340	674	877	400
Custom work	194	250	236	163	154	215	203	232	124	222	92
Taxes	241	318	309	265	215	303	281	264	120	141	83
Other expenses	530	468	697	681	457	633	656	557	370	445	276
Feed bought per T.A.	$ 10.22	$ 13.09	$ 13.65	$ 9.26	$ 22.00	$ 9.55	$ 7.37	$ 9.77	$ 5.50	$ 7.99	$ 11.15
Crop expenses (less custom) per T.A.	7.51	7.98	8.53	24.83	5.92	6.65	6.05	9.71	4.57	6.26	3.84
Custom work per T.A.	1.21	1.47	1.15	1.27	1.21	1.17	1.08	1.68	.84	1.59	0.88
Real estate tax per T.A.	1.51	1.87	1.51	2.07	1.68	1.66	1.50	1.92	0.82	1.01	0.80
Other expenses per T.A.	3.32	2.75	3.40	5.33	3.60	3.45	3.51	4.03	2.51	3.16	2.64

*Includes operator's and family labor, but not interest on investment. †Fruit farms excluded.

DEHYDRATED LETTUCE MEAL PIGMENTS BROILERS

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Agricultural Chemistry

Buyers of live and New York-dressed poultry frequently pay a premium for broilers with golden-yellow shanks, because they associate this color with better finish and with better health. This is probably based on the fact that when birds go out of condition they gradually bleach out and lose fat from their tissues. A golden-yellow color is also desired in the yolks of eggs by most consumers—particularly by those who manufacture cake and doughnut mixes and noodles.

These poultry products get their yellow color chiefly from yellow corn and dehydrated alfalfa meal as well as from herbage when the birds are on range. The coloration is due to the xanthophylls, a group of fat-soluble, carotenoid-type pigments which occur in nature as mixtures very difficult to separate in the laboratory. When eaten, most of this type of pigment is excreted unchanged, but an important amount is absorbed by "yellow-skinned" breeds of chicks to color their shanks, beaks, fat depots, and skins; and by all breeds to color their egg yolks.

In Michigan and the Midwest, yellow corn and dehydrated alfalfa meal are readily available and are basic ingredients in poultry feeds. Certain conditions, however, affect the levels at which these feedstuffs are found in poultry feeds. For example, such factors as the relative size cereal grain crops and their carry-overs from year to year, the current tendency to increase the energy content of feeds by reducing the levels of higher-fiber alfalfa meal, and the relative abundance or absence of green feed on local ranges at different times of the year determine how much of these feedstuffs are consumed by poultry and in turn affect the depth of color of poultry products. Furthermore, in

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TABLE 1—Composition of dehydrated lettuce meal as reported

Xanthophyll	380 mg./lb.
Carotene	182 mg./lb.
Tocopherol	0.2 grams/lb.
Vitamin K	75 mg./lb.
Protein	21.5%
Fat	5.4%
Fiber	18.3%
Ash	11.0%
Moisture	8.0%
Weight	23.5 lbs./cubic feet
Size	20-80 mesh

many areas of the world, yellow corn and alfalfa meal are not available or economically competitive with locally-grown, less-pigmented feeds.

Due to these conditions, sources of concentrated, xanthophyll-rich feed ingredients are used by some feed manufacturers to provide the desired pigmentation uniformly throughout the year or from region to region so that the producer may obtain premium prices for broilers and eggs.

One product that would seem to offer promise in this respect is dehydrated lettuce meal. This is the dried lettuce waste composed of the outside leaves and poorly formed heads obtained as byproducts of the table market crop. The meal is stated to have the composition shown in Table 1. It is darker green and somewhat heavier than new alfalfa leaf meal; free flowing, and not dusty. Its carotene-xanthophyll content is claimed to stand up better in storage than that of alfalfa meal.

Since commercial quantities of dehydrated lettuce meal have recently become available, it was decided to investigate its pigmentation potentialities in the ration for broilers.

EXPERIMENTAL AND DISCUSSION

First feeding test—Groups of 25, 5-week-old White Leghorn cockerels, previously fed a normal-pigment starting ration containing 54 percent corn and 2.5 percent dehydrated alfalfa, were placed on a low-pigment diet (Table 2) alone and with lettuce meal as shown in Table 3. A third group was continued on the normal-pigment diet. The birds were placed in floor pens on peanut shell litter. Feed was mixed only once in quantities sufficient to satisfy requirements for the

entire period, so it is possible that some destruction of pigments took place before it was fed toward the end of the feeding experiment.

In 10-days to 2-weeks time, it was observed that the shanks of the birds on the low-pigment ration had substantially less color than those on the normal ration. At 2 weeks, the birds on lettuce meal had shanks similar in color to that of the normal control. After 3 weeks, shank color of the birds were scored by comparison with an egg-yolk color chart (Poultry Science 22, 102-107, 1943). The results are shown in Table 3.

It is apparent that 10 percent of dehydrated lettuce meal provided pigmentation which compared favorably with that of the normal-pigment ration.

Second feeding test—Groups of 10 5-week-old and 10 6-week-old White Leghorn cockerels, previously given the normal-pigment diet, were fed in batteries the low-pigment ration containing 0, 20, and 40 pounds per ton of dehydrated lettuce meal. This meal was mixed with the feed weekly. Two similar groups were also continued on the normal-pigment ration. All groups were fed the experimental rations for another 4 weeks after which gross observations were made of the

TABLE 2—Composition of chick starting mashes

	Normal Pigmented Feed	Light Pigmented Feed
Ground wheat	.....	364
Ground barley	.....	150
Ground corn	540	.....
Soybean oil meal	250	250
Pulverized oats	50	100
Wheat middlings, standard	50	50
Alfalfa meal, dehydrated, 20% protein	25	.....
Meat and bone scraps, 50% protein	30	30
Fish meal, red	25	25
Di-calcium phosphate	12.5	12.5
Ground limestone	12.5	12.5
Trace mineral premix	0.5	0.5
Salt, iodized	5	5
Vitamins A & D supplement (4000-A, 750-D)	1	2
Vitamin B-complex (Fortafeed 249-C)	1	1
Vitamin B_{12} and antibiotic feed supplement (Pro-pen with B_{12} "2:3")	0.5	0.5
Methionine	0.4	0.4
Total	1003.4	1003.4

TABLE 3—Effect of lettuce meal upon shank pigmentation

Ration from 5 weeks to 8 weeks of age	Color Gradation* at 8 weeks
Low-pigment	9
Low-pigment + 10% dehydrated lettuce meal	11.5
Normal pigment	12

*The greater the figure, the deeper the color.

TABLE 4—Percentage pigmentation of shanks and toe-web discs with respect to birds on normal-pigment diet

Diet and Treatments	Spectrophotometric Analysis of Toe-Web Discs	Visual Observations of Shanks
	%	%
Low-pigment	0	20
Low-pigment + 20 lbs./ton lettuce meal	32	60
Low-pigment + 40 lbs./ton lettuce meal	60	80
Normal-pigment	100	100

depth of color of the shanks. At the same time, a small disc was punched from the toe webs of each foot of the 9-week-old birds for spectrophotometric evaluation.

The gross observations were made by rating on a percentage basis the depth of color of the shanks of the birds in the experimental groups with respect to that of birds on the normal-pigment diet. The spectrophotometric evaluation of the discs from the toe webs was made by extracting the pigment with acetone and determining absorption at wave lengths of 422.5 mu., 445 mu. and 475 mu., which are characteristic peaks of xanthophyll absorption. The amount of pigment for each group was determined as a percentage of that extracted from the discs of birds on the normal-pigment ration.

It should be noted that the pigmentation was determined on the shanks by gross observation and on the webs between the toes by spectrophotometric test. It was obvious that there was a general relationship in coloration between shanks and webs. However, particularly on the shanks, there was considerable variation between individuals and between different areas of the same individual. On the whole, however, the spectrophotometric evaluation supports the judgments made independently on color of the shanks (Table 4).

It is apparent from the data that dehydrated lettuce meal added to the feed supplied xanthophylls which colored the skin of broilers. This effect took place in only 2- to 4-weeks time before the broilers reached market weights. This indicates that xanthophyll-rich ingredients may need to be fed only in a broiler finishing feed. Fed in this manner, maximum returns would be obtained from the amount of material used. Based upon current Michigan prices for carload lots of dehydrated lettuce meal, a step-up of roughly 30 percent of normal pigmentation was obtained by adding 20 pounds per ton at a cost of about $1.30.

ACKNOWLEDGMENT

This work was financed in part by funds from Bowman Feed Products, Holland, Michigan, which also contributed the dehydrated lettuce meal.

THE RELATION OF MOISTURE CONTENT AND BALE DENSITY TO HAY QUALITY[1]

By R. B. HOPKINS,[2] D. E. WIANT,[3] and H. R. PETTIGROVE[4]

It is difficult to make high quality field-cured hay in such humid areas as Michigan. This is especially true in June and early July when frequent rains occur. In addition to the difficulty of securing complete field-curing, there is also a considerable loss of nutrients from bleaching by the sun, leaching by rain, and shattering of leaves when handling the dry hay.

The length of field-curing time and the nutrient losses can be reduced by storing hay at a higher moisture content. The development of mold in stored hay is not determined by moisture content alone. It appears that bale density, that is the weight per unit volume, also exerts an influence. If we consider a windrow of hay in the field, we expect a loosely formed windrow to dry more rapidly than one that is tightly formed, because the loose windrow permits better air circulation. Likewise, more rapid drying can be expected in stored hay if it is loosely packed.

Eggleton (1953) reported the results of a preliminary test in 1952 in which bales were stored on end with several inches of free space between bales. It resulted generally in must- and mold-free hay at bale densities below 9 pounds per cubic foot. A 14 by 18 by 40 inch bale with a density of 9 pounds per cubic foot weighs 53 pounds.

Further tests were made in 1953 in which the bales were stacked more closely together. These tests were conducted to determine the relation of moisture content and bale density to hay quality under more conventional storage conditions and will be discussed in detail.

[1]Acknowledgments: The authors wish to thank the J. I. Case Company for providing equipment and financial assistance to aid in this work.

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TEST PROCEDURE FOR 1953

The tests were conducted on the first and second cuttings of alfalfa from farms in the vicinity of East Lansing. The first cutting, which contained a mixture of grasses, was mowed on the afternoon of July 2 and baled on the afternoon of July 4. The second cutting was mowed on the morning of August 11 and baled on the afternoons of August 13 and 14 after an intervening cloudy day with a trace of rain.

The hay was mowed with a tractor-mounted mower and raked when it had dried to a moisture content of approximately 50 percent.[5] Baling was started when the moisture content was approximately 30 percent. A field pickup twine-tie baler which formed bales 14 by 18 by 40 inches was used. The bales were loaded directly onto wagons and hauled to storage.

The baling was done over a period of time in which the hay dried from approximately 30 percent to 20 percent. Several times during this interval the bale density was varied to produce a range of densities from the minimum possible to a maximum of approximately 11 pounds per cubic foot. Three test bales were formed at each density.

At the storage, each bale was sampled by boring approximately one-half the length of the bale with a tube. The core collected in the tube was dried to determine the moisture content of the bale. Since all of the bales were the same size, the bale density was computed from the weight of each bale. The hay was stored in a bin of the Case Hay Laboratory which has a wire mesh floor three feet above the ground and also has two sides open to the weather.

This storage condition is referred to as natural draft ventilation. A gap of approximately 2 inches was left between bales when they were stacked in the bin. After a period of four weeks, the bales from the first cutting were inspected for must and mold. The hay from the second cutting was inspected after eight weeks storage.

DISCUSSION OF RESULTS

Terry (1947) reported that bin-stored hay which was dried below 20 percent moisture content within 3½ days was of good quality and free from visible mold. Accordingly, the critical period for storage of high moisture content hay would be approximately the first 3 days of storage. In this interval the air temperature and relative humidity would influence the drying rate of the hay and the development of must and mold.

[5] All moisture contents are given on the wet basis.

During the first three days of storage of the first cutting the average official temperature was 73° F. and the wind velocity 11.1 miles per hour southwest according to the U. S. Weather Bureau in East Lansing. The normal average temperature for the month of July is 71° F. The corresponding average temperature for the first three days of storage of the second cutting was 67° F. with a southwest wind 9.1 miles per hour. The normal average temperature for the month of August is 69° F.

The average relative humidities[6] for the first three days of storage of the two cuttings were 60 and 62 percent, respectively, as compared to 20 year averages of 62 and 65 percent for the months of July and August respectively. According to these data, the average temperatures and relative humidities during the first three days of storage were approximately normal and were about the same for both cuttings.

The data from both cuttings are reported in Fig. 1. This figure shows the quality of individual bales in relation to density and moisture content. The "lower limit of musty bales" indicates the minimum conditions of density and moisture content at which mustiness occurred. The "upper limit of must-free bales" passes through the points of maximum density and moisture content at which bales were found free of must. Above the upper limit all bales were musty, while below the lower limit all bales were free of must. The area between the limit lines includes a range of densities and moisture contents at which both musty and must-free bales were found. *This variation in quality occurs because of variations of density and moisture content within individual bales.*

The observed values of density and moisture content represent an average condition within the bale, while the development of must is more likely related to the maximum conditions of density and moisture content. That is, a bale having an average moisture content low enough to prevent must and mold growth, may have small, damp, dense portions which will become musty and moldy in storage.

Varying degrees of mustiness were observed in the bales falling in the area between the limit lines. In general, as the lower limit of musty bales was approached, the degree of mustiness decreased to such an extent that only an experienced inspector would be likely to detect its presence.

The slope of the limit lines indicates that to obtain must-free hay, the bale density must be decreased as the moisture content is increased.

[6]Computed from official observations at 7 a.m., 1 p.m., and 7 p.m.

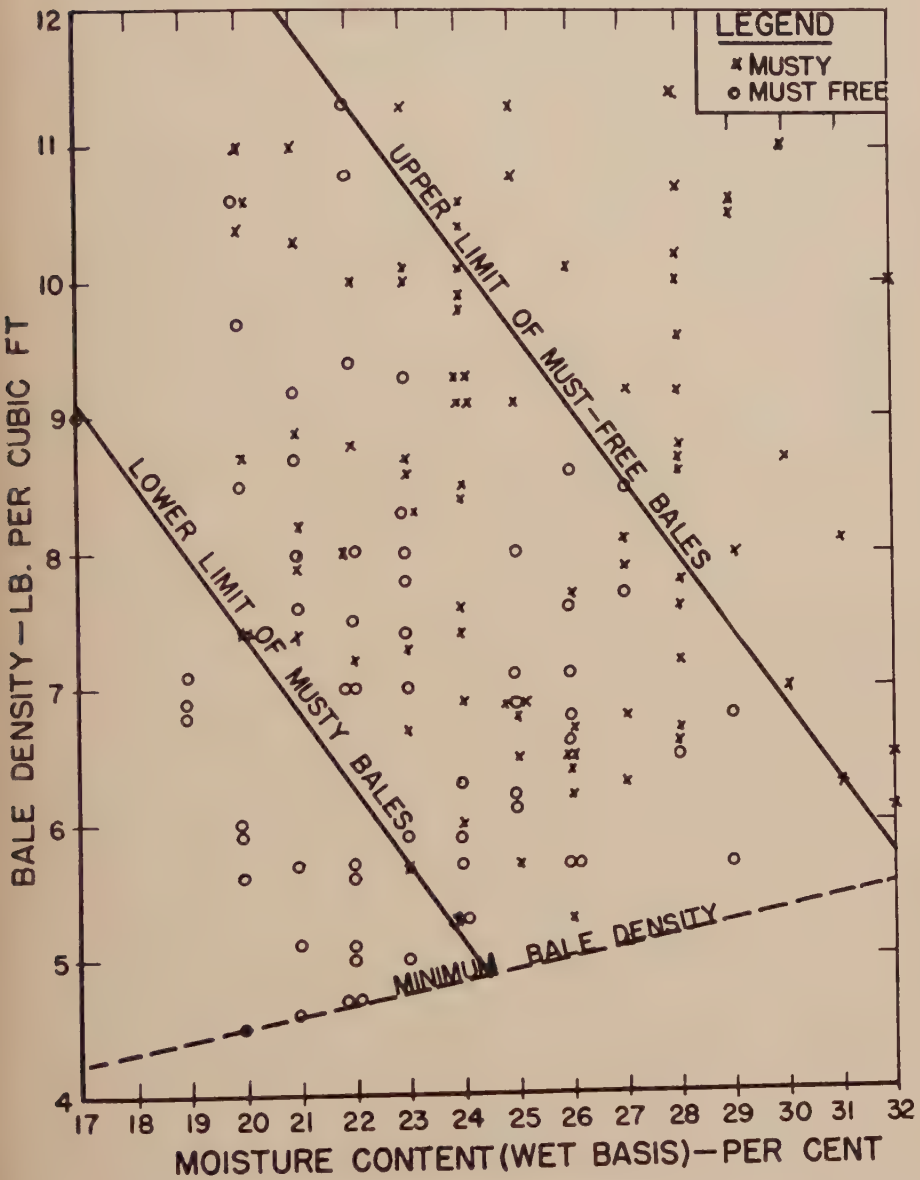

Fig. 1. Quality of individual bales in relation to bale density and moisture content.

If the area between the limit lines is divided into parallel strips of equal width, a gradual reduction of the percentage of must-free bales is found as the upper limit is approached. This, together with the slope of the limit lines, shows that a definite relation exists between bale density, moisture content, and quality.

Kleis (1949) and Richards (1950) made surveys of hay quality in the Lansing area. The surveys covered one first cutting and two second cuttings of alfalfa hay. Fifty-six percent of the bales from the first cutting were musty or moldy, while 39.2 percent of the bales from the second cuttings were musty or moldy. The bales ranged in density from 6.7 to 14.0 pounds per cubic foot with an average density of 10.8 pounds per cubic foot. Ninety-three percent of the bales had a density of 8 pounds or more per cubic foot.

The results presented in Fig. 1 indicate that completely must-free hay cannot be obtained under Michigan conditions at bale densities of 8 pounds or more per cubic foot with natural draft ventilation if the moisture content is above 19 percent. Thus, in order to obtain hay which is entirely free of must and mold, it is necessary to form bales of approximately 6 pounds per cubic foot density (35 pounds for a 14 by 18 by 40 inch bale) at moisture contents around 20 percent. Such bales require careful handling and it is difficult to cure hay to 20 percent moisture content in humid or rainy weather.

The *complete* absence of must is not a matter of primary concern in hay which is fed on the farm, because good results can be obtained with slightly musty hay. Occasional musty portions, such as may occur from the presence of a succulent weed or a wad of uncured hay, represent only an insignificant loss. If an occasional spot of must is acceptable, hay can be compressed to somewhat higher densities or loosely baled at higher moisture contents. However, dense bales of moist hay should be avoided because of the loss of food value and palatability resulting from the formation of must and mold and also because of the danger of spontaneous combustion in the hay.

SUMMARY

Tests were conducted to determine the relation of bale density and moisture content to quality of alfalfa hay stored in a natural draft ventilation mow. The results show that both bale density and moisture content at the time of storage affect the final quality of the hay.

In order to obtain completely must-free hay under Michigan conditions, with natural draft ventilation, the hay should be dried to about

20 percent moisture content before baling, and the bale density should be about 6 pounds per cubic foot. When hay is compressed to higher densities, completely must-free hay cannot be expected. If some mustiness in a few of the bales is acceptable, the hay can be baled at slightly higher moisture content or compressed to somewhat greater density.

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JOURNAL ARTICLE ABSTRACTS

A New Medium for the Detection of Enterococci in Water

LITSKY, WARREN; W. L. MALLMANN AND C. W. FIFIELD

Amer. Jrnl. of Public Health 43:873-879. 1953. (Journal Article 1437 from the Michigan Agricultural Experiment Station)

A medium has been developed for confirming the presence of enterococci in water by transferring from dextrose azide broth, the primary presumptive medium. The medium contains ethyl violet in proper concentration to inhibit streptococci, other than the enterococci and other gram positive bacteria. It also contains sodium azide to inhibit the growth of gram negative organisms. The medium is specific for enterococci so that clouding of the medium may be used as a positive test. The dextrose azide broth and ethyl violet azide broth combination offers a dependable method for detecting enterococci.

Soil Factors Affecting Constant Water Level Sub-Irrigation

COOK, R. L.; A. E. ERICKSON AND P. R. KRONE

Proc. Amer. Soc. for Hort. Science 62:491-496. 1953. (Journal Article 1444 from the Michigan Agricultural Experiment Station)

Snapdragons were grown in glazed tile which varied in height from 8 to 24 inches. They were placed in shallow pans of water to simulate constant water level sub-irrigation. Oshtemo sandy loam and Brookston clay loam were used. Fertilizer was applied uniformly to all pots. In the sandy loam, best quality blooms grew where the soil depth was 21 inches to the water table. Poor aeration and poor growth resulted where the soil column was more shallow.

In the clay loam, 9 inches of soil produced the best blooms. Where the soil depth was 13 inches or more, surface watering was necessary to get the plants started. After surface watering was discontinued, the soil in these deeper pots soon dried to a point where the water-air ratio was too low for good growth. Based on these results, sandy soil should extend 21 inches above the water table for success with constant water level sub-irrigation. For clay loam soils, the depth may be reduced to 9 inches. These figures might vary with crop, soil texture, and degree of soil aggregation.

Changes in the Criteria Used in Soil Classification Since Marbut

WHITESIDE, E. P.

Soil Science Soc. of Amer. Proc. 18:193-195. 1954. (Journal Article 1454 from the Michigan Agricultural Experiment Station)

The changes in the criteria used in soil classification since Marbut's time are presented. These changes are of three kinds—1) additions to the list of properties used, 2) refinements of the properties formerly used and 3) deletions from the list of properties formerly used.

The additional properties now being used are mainly properties of the whole soil body. Most important among these are the properties which are independent

variables of the soil system. The introduction of these independently variable properties of the soil body, for use in soil classification, presents the poignant possibility of fusing the genetic and descriptive systems of soil classification without abandoning the premise that soils should be classified on the basis of their properties. The effect of the above changes in soil classification on the definition of the soil individual—the soil type—and its nomenclature is discussed.

Dry Mix and Frozen Baked Products I. Dry Mix and Frozen Cakes II. Dry Mix and Frozen Muffins

PAUL, PAULINE; O. M. BATCHER AND LILIAN FULDE

Jrnl. of Home Econ. 46:249-254. 1954. (Journal Article 1511 from the Michigan Agricultural Experiment Station)

I. *Yellow Cakes.* A comparison was made of yellow cakes prepared in the following ways: fresh, frozen-batter, frozen baked, home-prepared mix, and commercially prepared mix. The frozen and mix cakes were tested after 0, 1, 2, 4 and 6 months of storage. Fresh cakes were prepared at each testing.

White Cakes. The study on white cakes was very similar to that of yellow cakes. The storage periods used were 0, 1, 2, 4 and 7 months.

General. In comparing the results of the two different types of cakes, the following points seem most important to the home user:

Characteristics	*Yellow Cake*	*White Cake*
Most palatable	Fresh	Commercial Mix
Least time to make	Commercial mix	Commercial Mix
Least expensive	Home-prepared mix	Fresh
Least palatable	Commercial	Frozen-batter
Most time to make	Frozen baked	Frozen baked
Most expensive	Commercial mix	Home-prepared mix

II. The quality of muffins prepared of fresh batter, home-prepared mix, and commercial all-purpose mix, and thawed muffins that had been frozen were compared. Evaluations were made after the samples had been in storage 1, 2, 4, 6 and 9 months.

The results indicated that muffins made from commercial all-purpose mix compared favorably with muffins made from fresh batter. Muffins prepared from home-prepared mix were also satisfactory, though the texture was more cake-like than the texture of a typical muffin. The muffins which had been frozen were similar to the fresh-batter muffins until the 6 months' storage period. After that, palatability scores decreased, probably because of the changes in flavor and odor after storage.

Water Quality Yardsticks

MALLMANN, W. L.

Jrnl. Amer. Water Works Assoc. 45:917-926. 1954. (Journal Article 1518 from the Michigan Agricultural Experiment Station)

The pros and cons are submitted for the continuance of the present sanitary standards for water supplies. The paper presents by the submission of data that the present standards are adequate and that neither a relaxing or lightening of standards would be justified. There is a need for better laboratory evaluations and a need for a new test organism for evaluating rural water supplies.

Influence of the Thyroid Status on Volume and Concentration of Cock Semen

WILWERTH, A. M.; C. MARTINEZ-CAMPOS AND E. P. REINEKE

Poultry Science 33:729-735. 1954. (Journal Article 1559 from the Michigan Agricultural Experiment Station)

The feeding of thiouracil as 0.1 percent of the ration to a group of 12 Rhode Island Red cocks for a period of 4 weeks caused a small, but statistically non-significant trend toward lower semen volume and concentration. Replacement of the thiouracil in groups of 3 birds with 0.01, 0.02 and 0.04 percent thyroprotein during a 3 week period caused a significant increase in semen volume, the greatest effect being observed at the highest level.

In a second experiment conducted on groups of 5 cocks, 0.04 percent thyroprotein significantly increased sperm concentration with no effect on semen volume. Levels of 0.08 and 0.16 percent thyroprotein significantly reduced both semen volume and concentration.

Polarographic Determination of Zinc in Plant Materials

HINSVARK, O. N.; W. H. HOUFF; S. H. WITTWER AND H. M. SELL

Analytical Chem. 26:1202. 1954. (Journal Article 1562 from the Michigan Agricultural Experiment Station)

Zinc in plant material is determinable with a minimum of effort and manipulation by utilizing the zincate polarographic curve. The ashed sample is treated with a 1 M tetrasodium versenate solution to prevent coprecipitation of the zinc in the sample, then dissolved in 1.5 N NaOH to obtain essentially all the zinc as the zincate ion. Zinc values obtained by this polarographic technique agree favorably with those obtained by standard A. O. A. C. methods.

Comparison of Band Seeding and Other Methods of Seeding Legumes

TESAR, M. B.; K. LAWTON AND B. KAWIN

Agron. Jrnl. 46:189-194. 1954. (Journal Article 1567 from the Michigan Agricultural Experiment Station)

Twenty-two percent more legume seedlings were obtained when legume seed was placed in a 1-inch band on top of the ground directly over fertilizer drilled 1½ inches deep in 7-inch rows than when the seed was broadcast over similarly fertilized soil. Alfalfa *(Medicago sativa)* and birdsfoot trefoil *(Lotus corniculatus)* were the legumes used. The band seeding method also resulted in much more vigorous and taller plants.

Greenhouse tests with radioactive P corroborated field results showing superiority of placing all the legume seed over the fertilizer in the field. Seedlings had to be directly over or within an inch of the fertilizer band in order to obtain 60 percent or more of their phosphorus from the fertilizer during the first two months of growth. Seedlings 3 or 4 inches away from the fertilizer—similar to many seedlings seeded by broadcast methods in the field—absorbed less than 25 percent of their phosphorus from the fertilizer. Low absorption of phosphorus by seedlings this far from the fertilizer was further reflected in greatly decreased vigor. It explains why many seedlings perish when established by broadcast seeding in the field. They perish before getting appreciable stimulation from applied fertilizer.

Sufficient evidence is available for implement companies to manufacture adapters which will convert regular grain drills with fertilizer and legume sealer attachments into band seeders. The adapters should place the legume seed on top of the soil in a narrow band above the fertilizer and small grain drilled from 1 to 2 inches deep.

X-Ray Diffraction of Common Silica Minerals and Possible Applications to Studies of Soil Genesis

POLLACK, S. S.; E. P. WHITESIDE AND D. E. VAN VAROWE

Soil Science Soc. of Amer. Proc. 18:268-272. 1954. (Journal Article 1581 from the Michigan Agricultural Experiment Station)

A qualitative X-ray diffraction study indicated that quartz was present in all of 16 silica minerals. Jasper was the only sample found to contain a crystalline impurity and this was identified as hematite.

A standardized sample preparation and mounting technique is described herein. Quantitative estimates of the quartz contents of three phenocrystalline varieties and two cryptocrystalline varieties of quartz were made. The cryptocrystalline varieties showed much less intense diffraction by the 3.35 A° spacing characteristic of quartz than did the phenocrystalline varieties. The available evidence indicates that these differences are probably due to fundamental differences in the nature of the quartz in these two groups. However, the possibilities of the presence of some amorphous diluents and variable particle sizes have not yet been completely eliminated.

The implications of these findings for the use of X-ray diffraction procedures for the determination of quartz in soils and the study of soil genesis are discussed.

Control of Seedstalk Development in Celery by Maleic Hydrazide

WITTWER, S. H.; H. JACKSON AND D. P. WATSON

Amer. Jrnl. of Botany 41:435-439. 1954. (Journal Article 1583 from the Michigan Agricultural Experiment Station)

Maleic hydrazide applied to Cornell 19 celery plants at various stages of growth had a marked influence on subsequent seedstalk development. Spray concentrations of 50 to 100 p.p.m., applied before cold induction to young plants having 8 to 10 true leaves, specifically induced flowering in many plants which otherwise would have remained vegetative. Higher concentrations (500 to 1000 p.p.m.) of maleic hydrazide applied at much later stages of growth (37 true leaves) retarded the development of seedstalks. The significance of these results are discussed in relation to the auxin economy of the stem apices as a controlling mechanism in flower initiation.

The Characteristics of Some Soils on Tills of Cary and Mankato Age in Michigan

ALLEN, B. L., AND E. P. WHITESIDE

Soil Science Soc. of Amer. Proc. 18:203-206. 1954. (Journal Article 1585 from the Michigan Agricultural Experiment Station)

Field and laboratory studies were made of the well drained soils and the associated loamy tills of the Cary and Mankato substages of the Wisconsin in Sanilac County, Michigan.

The soils on the Cary till were deeper, more acid, and more clearly differentiated into horizons than those on the Mankato till. The mean carbonate content and depth of leaching of the Mankato till were 31.4 percent and 20 inches respectively. The mean carbonate content and depth of leaching on the Cary till were 22.4 percent and 29 inches respectively. The soil profile studied on the Mankato till was more permeable in all horizons on the Cary till. The horizons—the glacial tills—were the most impermeable parts of both profiles.

Calculations using these data, and assuming 11,000 years as the length of post-Mankato time, indicate that the duration of the Cary-Mankato interglacial stage was 1,100 to 5,500 years. Further work is needed on this point.

Demand Analysis from the M. S. C. Consumer Panel

QUACKENBUSH, G. G.

Jrnl. of Farm Econ. 36:415-427. 1954. (Journal Article 1594 from the Michigan Agricultural Experiment Station)

The M. S. C. Consumer Panel consists of about 250 families who report each week in considerable detail on their food purchases. Each family reports the quantity, price and expenditure for each food item purchased. About 500 food items are included, and this includes all food. Each family reports its income for the week. The sample area to date has been the city of Lansing, Michigan. The project was designed to continue for 10 years.

The objectives of the project are to determine price, income, and cross elasticities, as well as purchase patterns for food.

Examples of current research include use of single equation least squares methods to derive price elasticities for beef, pork, poultry, fish, cold cuts, individual cuts of meat (steaks, roasts, hamburger, etc.), and some fats and oils.

It is concluded that the consumer purchase panel method has considerable potential as a method of securing data for demand analysis and related studies.

The Effects of Corncob Mulches and Incorporate Soil Mixtures on Physical and Chemical Properties of the Soil

CARPENTER, W. J., AND D. P. WATSON

Soil Science 78:225-229. 1954. (Journal Article 1599 from the Michigan Agricultural Experiment Station)

Immediately following the application of freshly ground corncobs as surface mulches or soil mixtures, there occurred a large reduction in the nitrate concentration of the soil and the oxygen content of the soil air. Growth of plants supplied with the mulch treatment appeared to be reduced.

The aeration study indicated that although the percentage of aggregation, average diameter of the aggregates, and total porosity were increased in a soil beneath a surface mulch of ground corncobs, the percentage of oxygen in the soil atmosphere was less than the oxygen content in the soil of the non-mulch treatments.

Although the reduced soil temperature as well as the reduced fluctuation of soil temperature beneath the mulch was a possible benefit to growth, a great retention of soil moisture was likely the most important benefit the plant received from the use of the mulching material.

The Nutritive Value of Corn Silage for Milking Cows

HUFFMAN, C. F., AND C. W. DUNCAN

Jrnl. of Dairy Sci. 37:957-966. 1954. (Journal Article 1606 from the Michigan Agricultural Experiment Station)

Corn silage replaced a part of the hay in an all-hay ration in 23 trials using 16 milking cows. The periods on hay and corn silage varied from 16 to 60 days. Nine different corn silages were used including one Eureka corn silage. Corn fields were randomized just prior to ensiling in 4 different crop years, and the data indicate that each 100 lb. of corn silage contained 13 to 17.4 lb. of corn grain in addition to the cobs and stalks, excluding the Eureka corn silage.

Fat-corrected milk increased per lb. of total digestible nutrients (T.D.N.) in 22 of 23 trials when the cows were fed corn silage. No significant differences occurred in the percent butter fat in the milk or in body weight of the cows when part of the hay was replaced with corn silage. The data show conclusively that the grain in corn silage contributes the unidentified grain factor(s) which is needed to balance the T.D.N. in roughages. An allowance should be made for the grain in corn silage when feeding to milking cows.

A Study of Serological Cross Reactions Between the Brucella and Certain Salmonellae. II. The Amount of the XII_2 Antigen Present in Brucella and Salmonella pullorum #BAI (Variant Strain), Salmonella Reading, and Proteus (Gwatkin Strain)

SHKLAIR, I. L., AND H. J. STAFSETH

M. S. C. Vet. 14: 136-139. 1954. (Journal Article 1632 from the Michigan Agricultural Experiment Station)

The purpose of this investigation was to determine the amount of XII_2 antigen present in Brucella and in *Salmonella pullorum BAI* (variant strain), S. *reading*, and S. *proteus* (Gwatkin strain). Reciprocal agglutination tests were carried out between Brucella and other organisms, S. *reading* and *Proteus* (Gwatkin strain), which contain antigen XII_2. The cross-reactions observed between these organisms and Brucella were less pronounced than those noted between S. *pullorum BAI* and *Brucella*. There appears to be a difference in the amount of the cross reacting antigen (for Brucella) in S. *pullorum BAI*, S. *reading*, and S. *proteus* (Gwatkin strain). Whether this is a strain characteristic of the organisms involved is not known. Agglutinin absorption studies carried out with S. *pullorum BAI* and Brucella indicated that the antigen common to S. *pullorum BAI*, S. *reading*, and S. *proteus* (Gwatkin strain) existed in approximately equal amounts in all three species of Brucella tested.

SHKLAIR, I. L., AND H. J. STAFSETH

M. S. C. Vet. 14: 140-142. 1954. (Journal Article 1633 from the Michigan Agricultural Experiment Station)

The purpose of this investigation was to determine the cross-reactions between *Salmonella pullorum* and Brucella obtained with sera of turkeys, naturally infected with S. *pullorum*, with respect to cross-agglutination with Brucella. One hundred and seventy-six S. *pullorum*-suspicious and reactor turkeys were tested, using

Br. abortus 2308 and *Br. melitensis* 2500 antigens in dilutions of 1:25, 1:50, and 1:100. Of this total, 29 (17 percent) showed a cross-reaction with the Brucella antigens.

A Study of Serological Cross Reaction Between the Brucella and Certain Salmonellae. III. A Study of Sera of Turkeys, Naturally Infected with Salmonella pullorum, with Respect to Cross Agglutination with Brucella

Negative Effects of Antibiotics on Thyroid Gland

LIBBY, D. A.

Science 120:354. 1954. (Journal Article 1635 from the Michigan Agricultural Experiment Station)

Penicillin and aureomycin were fed to rats and chicks to determine whether they inhibited thyroid function. Neither substance altered thyroid weight nor reduced the uptake of radioactive iodine (I^{131}) by the thyroids of the rats. Arsanilic acid also failed to influence thyroid weight when fed to chicks. These results contradict a recent report by B. Calesnick, W. D. Harris and R. S. Jones (Science 119:128. 1954) but confirm previous experiments reported by us.

In Vitro Sensitivity of *Corynebacterium renale* to Seven Antibiotics

LARSON, E. J.; M. L. GRAY; F. THORP, JR., AND S. L. LAINE

M. S. C. Vet. 14: 143-145. 1954. (Journal Article 1636 from the Michigan Agricultural Experiment Station)

The *in vitro* effect of seven antibiotics (aureomycin, bacitracin, chloromycetin, dihydrostreptomycin, penicillin, polymixin B, and terramycin) was determined by the commercial antibiotic disk method (Difco) against 25 strains of *Corynebacterium renale* and *C. renale*-like diphtheroids. The results suggested that penicillin or bacitracin were the antibiotics of choice for treating infections with these microorganisms. Penicillin is to be preferred because of its lower toxicity.

Integration of Dairy-Processing Equipment

HALL, C. W.

Ag. Engr. 35:574, 575, 578. 1954. (Journal Article 1661 from the Michigan Agricultural Experiment Station)

The margin of profit or loss in the operation of a dairy plant is frequently the result of care or carelessness in the selection of size, type and arrangement of equipment. This paper covers the selection of equipment of the proper size for various volumes of dairy plant operation.

The equipment from the receiving tank to the storage tank should be selected on the basis of the speed of the receiving room operation. The equipment from the storage tank to the bottler should be selected on the basis of the speed of the bottling or processing operation which completely utilizes the time of the workers. By integrating dairy processing equipment properly, it is possible to utilize labor and equipment most efficiently. Although one method of doing an operation may be less expensive on a unit basis, it may be desirable to select the more expensive unit operation because of its effect on other operations.

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